

1 8-20.1.INST1.ITS.DT1
2 Section 8-20.1 is supplemented with the following:
3
4 8-20.1.OPT1.ITS.DT1.MOD.docx
5 (*****)
6 **INTELLIGENT TRANSPORTATION SYSTEM (ITS)**
7 3a. Traffic Data Accumulation System
8 3b. Closed Circuit Television System
9 3c. Communication Conduit System
10 3d. Communication Cables and Interfaces
11 3e. Video, Voice & Data Distribution and Transmission System
12
13 8-20.1.OPT2.ITS.docx
14 (*****)
15 **Traffic Data Accumulation System**
16 This work shall consist of furnishing, installing, and testing all materials and equipment
17 necessary to provide a complete and operable extension to the existing Traffic Data
18 Accumulation system.
19
20 8-20.1.OPT3.ITS.DT1
21 **(NWR ITS October 11, 2004)**
22 **Closed Circuit Television System**
23 This work shall consist of furnishing, installing, and testing all materials and equipment
24 necessary to provide a complete and operable extension to the existing closed circuit
25 television (CCTV) system.
26
27 8-20.1.OPT4.ITS.DT1
28 **(NWR ITS February 11, 2002)**
29 **Variable Message Sign (VMS)**
30 This work shall consist of furnishing, installing and testing all materials and equipment
31 necessary to complete in place the variable message sign system, and when specified,
32 the modification of such an existing system.
33
34 8-20.1.OPT5.ITS.DT1
35 **(NWR ITS February 11, 2002)**
36 **Highway Advisory Radio (HAR) System**
37 This work shall consist of the following:
38
39 *** \$\$1\$\$ ***
40
41 8-20.1.OPT5(A).ITS.DT1
42 **(NWR ITS October 16, 2006)**
43 **Highway Advisory Radio Transmitter (HART)**
44 The Contractor shall furnish all labor, materials, tools, equipment and services for
45 the installation of a fully operational Highway Advisory Radio Transmitter (HART) as
46 intended by the Special Provisions and Plans. The HART shall include, but not be
47 limited to: electronics rack, amplitude modulated transmitter, power supply, voice
48 storage unit, digital communications module, equipment cabinet, antenna, pole,
49 conduits, conductors, junction boxes, and power and communication services.
50

1 The Contractor shall provide and install the HART as shown in the Plans. The
2 HART will be controlled remotely from the Traffic Management Center (TMC) at
3 Dayton Ave. in Shoreline by the use of Contracting Agency-owned communication
4 lines.
5
6 8-20.1.OPT5(B).ITS.DT1
7 **(NWR ITS February 23, 2009)**
8 **Highway Advisory Radio Sign (HARS)**
9 This work shall consist of furnishing, installing and testing of new sign and beacons,
10 sign control equipment and cabinet, and other equipment necessary to provide for
11 an operational highway advisory radio system as specified in these Special
12 Provisions.
13
14 8-20.1.OPT8.ITS.DT1
15 **(NWR ITS February 11, 2002)**
16 **Communication Conduit System**
17 This work shall consist of furnishing and installing the facilities used to mechanically
18 accommodate the communication components of the ITS System. The Contractor shall
19 be responsible for interfacing with the existing communications system and satisfying
20 system compatibility with regard to the existing facilities and this communications
21 system extension. Conduit shall be supplied as a system from a single manufacturer
22 providing all of the steel and PVC conduit; all required fittings, terminations, and other
23 installation accessories; all in accordance with the Plans, the Standard Specifications
24 and these Special Provisions.
25
26 8-20.1.OPT9.ITS.DT1
27 **(NWR ITS February 11, 2002)**
28 **Communication Cables And Interfaces**
29 This work shall consist of furnishing, installing and testing all materials and equipment
30 necessary to complete in place the communication cable and interface system and,
31 when specified, the modification of such an existing system.
32
33 8-20.1.OPT10.ITS.DT1
34 **(NWR ITS February 11, 2002)**
35 **Video, Voice, & Data Distribution And Transmission Systems**
36 This work shall consist of furnishing and installing all materials and equipment
37 necessary to complete in place the video, voice, and data distribution and video
38 transmission systems, and when specified, the modification of such existing systems.
39
40 8-20.1.OPT11.ITS.DT1
41 **(NWR ITS February 23, 2009)**
42 **Communication Hub / Concrete Universal Enclosure (CUE)**
43 This work shall consist of providing and installing a concrete universal enclosure (CUE),
44 mechanical and environmental system to support the requirements of the housed
45 equipment in four 19-inch rack frames, two 23-inch rack frames (6.9 feet in height).
46
47 8-20.2.GR8
48 **Materials**
49
50 8-20.2.INST1.ITS.DT1
51 Section 8-20.2 is supplemented with the following:

8-20.2.OPT2.ITS.DT1

Closed Circuit Television System

8-20.2.OPT2(A).ITS.DT1.docx

(*****)

Television Camera Assembly

Television cameras shall be supplied as a unit including camera with integrated lens, id generator, camera controller, pressurized environmental enclosure, pan and tilt mechanism and rain/sun shade. The camera assembly shall be a Helios 3960HD series camera positioning system, manufactured by CohuHD.

1. Equipment Model Numbers:

Helios camera system: Model HD35-7000

Camera Mounts:

Side pole mount: Model 8503-0

Wall mount: Model 8425-7

Pedestal: Model 7411542-001

2. Manufacturer Information:

CohuHD
12367 Crosthwaite Circle
Poway, CA 92064-6817
Telephone: (858) 391-1800
www.cohuhd.com

8-20.2.OPT2(B).ITS.DT1

(NWR ITS September 26, 2005)

Camera Pole(s)

The Contractor shall furnish and install round tapered steel poles for the CCTV camera installation, as shown in the Plans. The camera pole installation shall include the pole foundations for the CCTV camera installation and all associated mounting hardware. Pole hand holes shall have cover plates. They shall provide a flat mounting surface at the top of the pole to attach the camera assembly. The mounting plate shall have a 1.75-inch hole to pass the camera connector into the top section of the pole. The plate shall also provide predrilled 7/16-inch bolt holes in a 4.75-inch bolt circle to match the base plate of the camera assembly. The Contractor shall design the poles, hardware, and components to the requirements as shown in the Plans for each location.

Submittal

The Contractor shall submit all structural calculations and shop drawings to the Engineer for approval in accordance with Section 6-03.3(7), prior to fabrication of the poles and hardware.

8-20.2.OPT2(C).ITS.DT1

(NWR ITS February 23, 2009)

Existing Camera Pole(s)

When modifying an existing camera pole that currently has a heavy-duty pan/tilt unit and 8200 series camera mounted on it, the Contractor shall perform the following tasks:

- Modify the top of the pole by cutting a 1.75-inch diameter hole in the center of the mounting plate for the camera control cable to pass through into the top section of the pole. Paint the mounting plate with cold galvanizing paint to repair the finish damaged by drilling and cutting.
- Install a short pedestal mount (Pelco PM2010) on the modified base plate.
- Remove the existing pole-mounted junction box and cap the remaining holes.
- Install new camera and cable in accordance with the details.

8-20.2.OPT2(D).ITS.docx

(***)**

Camera Control Cabinet (Pad Mount)

The cabinet shall have the same external physical dimensions and appearance of Model 334 cabinets.

1. Cabinets shall be fabricated of 0.125" sheet aluminum, 5052 alloy, with mill finish, in accordance with Section 9-29.13(7)D, Item number 1. Painted or anodized aluminum is not allowed.
2. A spring loaded construction core lock capable of accepting a Best 6-pin core shall be installed on all doors accessing WSDOT equipment. A 6-pin green construction core shall be installed in each core lock. Upon contract completion, two master keys for each cabinet shall be delivered to the Engineer.
3. The cabinet shall be equipped with an electric strip heater with a rating of 100 watts and 120 VAC and a ventilation fan meeting the requirements specified in Chapter 12 of FHWA IP-78-16.
4. The fan and strip heater shall be controlled by a high-low adjustable thermostat, which can be set to ensure the cabinet interior temperature remains between 60°F and 125°F. The heater strip shall be shielded.
5. Two shatterproof fluorescent interior cabinet lights with self-starting ballast shall be furnished, one fixture mounted on the rear rack near the top and the second mounted at the top of the front rack. Door switches shall automatically turn on both lights when either door is opened.

1 6. The cabinet shall be equipped with a power distribution panel mounted on a
2 standard EIA 19-inch (ANSI/EIA RS-310-C) rack utilizing no more than five
3 RMU (8.75 inches). The following devices shall be provided with the power
4 distribution panel:

- 5
6 a. Duplex 120 VAC power receptacle.
7 b. Main circuit breaker, 120 VAC, 20 amp.
8 c. Four load circuit breakers, 120 VAC, 15 amp.
9 d. Neutral bus.
10 e. Ground bus.
11 f. Surge suppresser and filter unit, 120 VAC, 50 amp.

12
13 Power distribution panel components shall be mounted in or on the panel such that
14 they are readily accessible, provide dead front safety, and all hazardous voltage
15 points are covered to prevent inadvertent contact.
16

17 7. One controller unit shelf, which attaches to the front and back rails of the EIA
18 rack, shall be provided. The shelf shall be fabricated from aluminum and shall
19 contain a roll-out flip-top drawer for storage of wiring diagrams and manuals.
20

21 8-20.2.OPT2(E).ITS.DT1

22 **(NWR ITS September 26, 2005)**

23 **Camera Control Cabinet (Pole Mount)**

24 Camera control cabinets shall contain the equipment shown in the Plans. The
25 cabinet shall have the same features as the pad-mounted version except the
26 dimensions shall be 36 inches high, 24 inches wide and 18 inches deep and
27 include a single door. The cabinet and door shall meet the same requirements as
28 the pad-mounted version. The cabinet shall include the following:
29

- 30 1. Cabinets shall be fabricated of 0.125" sheet aluminum, 5052 alloy, with mill
31 finish, in accordance with Section 9-29.13(7)D, Item number 1. Painted or
32 anodized aluminum is not allowed.
33
34 2. Cabinet doors shall have a three-point latch and two-position stop assembly
35 with spring loaded construction core lock capable of accepting a Best Lock
36 Company 6-pin CX series core. The Contractor shall supply green construction
37 cores. Upon contract completion, the Contractor shall deliver two master keys
38 and one core removal key to the Engineer.
39
40 3. The cabinet shall be equipped with a rack-mounted power distribution panel.
41 The panel shall contain one duplex 120 VAC power receptacle for each
42 camera, main circuit breaker (120 VAC, 15 amp), ground bus, neutral bus, and
43 Surge suppresser and filter unit, (120 VAC, 50 amp). The power distribution
44 panel components shall be mounted in or on the panel such that they are
45 readily accessible, provide dead front safety, and all hazardous voltage points
46 are covered to prevent inadvertent contact.
47
48 4. Each camera control cabinet shall house one termination block for termination
49 of the camera control cable.
50
51 5. The Contractor shall provide and install a rack-mounted fiber optic patch panel
52 as shown in the Plans and as specified elsewhere in these Provisions.

6. The cabinet shall include a standard EIA 19-inch (ANSI/EIA RS-310-C) rack for mounting equipment.

8-20.2.OPT2(F).ITS.docx

(*****)

CCTV System Cabling

Cable connections between the camera system (Model 3965) and the control cabinet shall be as shown in the Plans. The cable ends shall be factory terminated. Cable installation shall only require installing the connector shell at the camera end, and modifying the power cable at the cabinet end. The cable used between the CCTV camera and the camera control cabinet shall be manufactured by Cohu.

1. Equipment Model Numbers:

Cable Assembly, 3965 control CA295E

8-20.2.OPT8.ITS.DT1

Variable Message Sign (VMS)

8-20.2.OPT8(A).ITS.docx

(*****)

Materials

Section 8-20.2 is supplemented with the following:

The sign display shall be supplied by the following vendor:

Daktronics, Inc.
331 32nd Ave,
P.O. Box 5128
Brookings, SD 57006-5128
Tel: (888) 325-8726
Fax: (605) 697-4700
Email: transportation@daktronics.com

Skyline Products, Inc.
2903 Delta Drive
Colorado Springs, CO 80910
Tel: (800) 759-9046
Fax: (719) 392-2075
Email: trafficsystems@skylineproducts.com

Sign Display

The sign display shall be a continuous matrix of pixels, 27 pixels high and 105 pixels wide. Each pixel shall be made from a grouping of amber light emitting diodes and contain no moving parts. The matrix of pixels shall be capable of displaying a message of 3 lines of text, 18 characters long. The sign display and other associated VMS components shall permit a test message using all 2,835 pixels, running at the maximum brightness and 100 percent duty.

VMS Sign Beacon

Three flashing beacons shall be installed on top of the sign housing. The beacons shall be as specified in Section 9-29.21. The 12 inch lamps shall be LED type, amber in color and meet the applicable portions of Section 9-29.16(2)A.

The beacons shall be aluminum and consist of single section, 12 inch traffic signal heads with cadet visor, square doors, and amber display. The center beacon shall flash alternatively to the two outside beacons.

Flashers for beacons shall be as specified in Section 9-29.15, with aluminum sheet metal cabinets. The sign controller shall operate the beacons as commanded by the NTCIP communications protocol.

Sign Housing

The VMS housing shall provide walk-in service access for all LED display modules, electronics, power supplies, environmental control equipment, air filters, wiring, and other internal VMS components. The internal size of the housing shall be a minimum of 6.25 feet high. The access doors shall be a minimum of 2 feet wide by 6.25 feet high.

Each access door shall be mounted to an integral frame, which bolts to the VMS housing frame using stainless steel hardware. A continuous vertical stainless steel hinge shall be used to support the door. In the closed position the door shall latch to the frame with a three-point draw-roller mechanism. The latching mechanism shall include a handle and release lever inside the VMS housing so that a person with no tools or keys cannot become trapped inside the housing. The door frame shall be flanged on all sides so that it sheds water. The door shall close around the flanged frame and shall compress against the one-piece closed-cell neoprene gasket that adheres to the door frame. Doors shall contain a stop to retain the door in the fully open (90 degree) position. The doors shall have a three-point latch and two-position stop assembly with spring loaded construction core lock capable of accepting a Best Lock Company 6-pin CX series core. Upon contract substantial completion, the Contractor shall deliver two master keys and one core removal key to the Engineer. Each door shall be provided with a door sensor that triggers the local sign controller to notify the central computer (via an NTCIP message) whenever either door is opened

The nominal external dimensions of the sign shall not exceed 26.5 feet in width, 8.5 feet in height, and 4.25 feet in depth. The VMS back and side housing walls shall be vertical. The front VMS wall shall be built at an angle of 3 degrees toward the viewing motorists. Display modules shall be parallel to the front VMS wall, so that use of the LED viewing cone is optimized. The dead load of the housing and contents shall not exceed 3750 lbs.

VMS housing exterior sheet material shall be 5052 aluminum alloy and shall have a minimum thickness of 0.125 inches. Exterior sheet seams shall be continuously welded and waterproof. VMS housing structural frame members (I-beams, C-channels, Zee-extrusions, and bar stock) shall be aluminum alloy number 6061-T6.

The minimum distance from the interior rear wall of the VMS housing to the closest display components shall be 36 inches. This free space shall be maintained across the entire interior of the sign housing, with the exception of structural members.

1 Structural members shall be designed and positioned so as to not be an obstruction
2 to free movement of maintenance technicians throughout the interior of the
3 housing. Circuit boards/display components shall be protected from accidental
4 contact by maintenance personnel.

5
6 VMS housings shall be constructed to present a clean, neat appearance, and the
7 equipment located within shall be protected from rain, snow, dirt, and corrosion.
8 Sign housing floors shall contain small weep holes for draining water that
9 accumulates due to condensation. Weep holes shall be fabricated in a manner
10 which prevents the entrance of insects.

11
12 The front of the LED display matrix shall be completely covered with polycarbonate
13 sheeting that is weather tight, ultraviolet (UV) light protected, non-glare, and which
14 has a minimum thickness of 0.17 inches. To achieve maximum display contrast and
15 legibility, the outside of the polycarbonate sign face shall be fully covered with a
16 mask, which is formed from aluminum sheeting. The mask shall have a minimum
17 thickness of 0.09 inches and shall contain a circular opening for each pixel. The
18 openings shall not hinder the 15° LED viewing angle. All exposed metal on the
19 VMS front face, which is visible to viewing motorists, shall be coated with black
20 Kynar 500 resin or an equivalent oven-fired fluoropolymer-based coating having a
21 minimum outdoor service life of 20 years. This shall include the aluminum face
22 mask, the aluminum border outside the LED display matrix, and all the mounting
23 and assembly hardware.

24
25 The VMS housing shall include a minimum of two (2) NEMA 20-R, 120 VAC duplex
26 electrical outlets, with ground-fault circuit interrupters. One duplex outlet shall be
27 located at each end of the inside of the VMS housing.

28
29 The VMS housing shall contain one (1) 4 foot, 40-watt fluorescent lamp for every 5
30 feet of VMS housing length. Lamps shall be evenly spaced across the inside roof
31 of the VMS housing, so they can provide uniform light distribution for night time
32 maintenance purposes. Fluorescent light assemblies shall be covered with a
33 protective wire cage. Fluorescent light ballasts shall be rated for operation at 0°F.
34 The fluorescent light circuit shall be controlled by a manual timer switch having an
35 adjustable on time of two (2) hours.

36
37 All VMS equipment, components, modular assemblies and other materials located
38 within the VMS housing shall be removable, transportable, and capable of being
39 installed by a single technician utilizing a one-person aerial lift truck. VMS
40 structural members are not included in this requirement.

41
42 Ribbon cable shall be protected at all points of physical contact where it touches
43 metallic frameworks. Either the ribbon cable or the frame, or both, shall be
44 wrapped with a protective covering where the cable touches the framework, to
45 prevent cable insulation rub-through from road induced vibration in the sign
46 framework.

47
48 The interior VMS environment shall be monitored and controlled by the sign
49 controller. Environmental control shall be designed to maintain the internal VMS
50 temperature at or below +140°F when the outdoor ambient temperature is at or
51 below +115°F. The VMS environmental control system shall consist of four primary
52 subsystems as follows:

Internal Temperature Sensors - The VMS shall contain two internally-mounted temperature sensors which are equipped with external thermocouples and which the sign controller continuously monitors. This temperature information shall be used by the sign controller to determine when to activate and deactivate the environmental control systems described herein. Sensors shall be located on opposite ends of the upper 1/3 of the LED display matrix, and their external thermocouples shall be attached to and make contact with an LED pixel circuit board.

The thermocouple and LED board shall be easily detached, in the event that one of the units requires removal and replacement. Sensors shall be capable of measuring temperatures from -40°F to +185°F. The sign controller shall automatically shut down the LED display whenever one or both sensors indicate that LED board temperature has exceeded +140°F. The sign controller shall automatically restart the LED display whenever the suspect temperature falls below +130°F. Both shutdown and re-start temperature thresholds shall be user-programmable. Sensor temperatures and VMS shutdown/re-start events shall be reportable to the VMS Central Software.

Housing Cooling System - The VMS housing shall contain a positive pressure cooling system which circulates outside air into the VMS housing whenever LED board temperature exceeds a user-programmable threshold. This system shall consist of enough ventilation fans as needed to exchange the internal VMS housing air volume at a minimum rate of 3.8 times per minute. Fans shall be the ball-bearing type.

There shall be one filtered air intake fan for each intake port. Intake fans shall be located in a line across the lower rear wall of the VMS housing. Intake fans shall contain a removable filter which shall remove airborne particles measuring 5 microns in diameter and larger.

Exhaust vents shall be placed in a line across the upper rear wall of the VMS housing and shall allow air out of the cabinet.

On the VMS housing rear exterior wall, all air intake ports and exhaust vents shall be covered on their top, front, and sides by an aluminum shroud fabricated from 0.090 inch aluminum sheeting. Shrouds shall be securely fastened to the VMS housing, and all shroud-to-housing interfaces shall be thoroughly gasketed to prevent water from entering the VMS. All air filters and fans shall be removable from inside the VMS housing.

The sign controller shall initially be programmed to activate the VMS housing cooling system whenever the LED board temperature exceeds +100°F and will turn the cooling system off whenever LED board temperature falls below +95°F.

The VMS housing cooling system shall be controllable by an adjustable timer that will turn fans off after the set time has expired. The timer shall be adjustable to at least four (4) hours, and it shall be located just inside the VMS housing door, within easy reach of a maintenance technician standing outside the VMS doorway.

LED Display Cooling System - The VMS shall contain an LED display cooling system, which directs air across the LED display modules whenever LED board temperature exceeds a user-programmable threshold. This system shall be comprised of fan-forced air directed vertically across the back side of the entire LED display matrix. The air source shall consist of multiple ball-bearing fans. The sign controller shall initially be programmed to activate the LED cooling fan system whenever LED board temperature exceeds +110°F and shall deactivate the system whenever LED board temperature falls below +105°F. Cooling fans shall be located so as not to hinder removal of LED display modules and driver boards.

Front Face Panel Defog/Defrost System - The VMS shall contain a defog/defrost system which circulates warm, fan-forced air across the inside of the polycarbonate front face whenever LED board temperature falls below a user-programmable threshold. The air source shall consist of multiple ball-bearing fans that provide uniform airflow across the polycarbonate face panel.

The sign controller shall initially be programmed to activate the defog/defrost system whenever LED board temperature falls below +40°F and shall deactivate the defog/defrost system whenever LED board temperature exceeds +105°F. A 100-watt pencil-style heating element shall be mounted in front of each defog/defrost fan and shall serve to warm the air directed across the VMS face. Heating elements shall be on only when the defog/defrost fans are on.

Personnel Restraint System

In the event that the sign installation does not include walkways or platforms at each of the VMS housing entrance doorways, a supplemental restraint shall be installed. The purpose of the restraint is to prevent workers inside the sign from inadvertently stepping out of an open doorway and falling to the ground below. The restraint system shall include guardrails to block any doorway that does not open to a walkway or platform. Each system shall include a top rail, mid rail, and toe board on the interior doors. The main interior entrances shall have rails in front of the door that are hinged and can be deployed as needed to block the doorway during the maintenance operation. The secondary door shall have fixed guardrails inside the door that completely block the doorway. These rails shall be vertical and horizontal in a grid with the largest opening measuring 18 inches on any side. The guardrails shall be attached by bolts or welded in-place. The personnel restraint system (guardrails) shall meet the criteria in WAC 296-155-505(7).

Lanyard Attachment Point

A personal fall restraint lanyard attachment point (anchorage) shall be installed on the outside of the VMS housing near each door. The point shall be installed opposite of the door hinge. The attachment point shall connect to the internal housing framework and meet the applicable criteria in WAC 296-155.

Sign Mounting Hardware

A VMS, sign structure, foundation, and a maintenance walkway are included in the construction. The sign housing shall be provided with all necessary hardware including sign mounting beams, vertical and horizontal brackets, maintenance walkways, and all related hardware to install the VMS.

1
2 The walkway shall be level with the bottom edge of the VMS. All mounting
3 hardware shall conform to the G series Standard Plans, the Standard Specifications
4 and the Plans. All nuts used in the mounting hardware shall be self-locking nuts
5 with nylon inserts. VMS's shall be attached or mounted to sign structures by means
6 of positive connections - defined as through-bolted connections. The use of clips or
7 clamps to accomplish the attachment or mounting of such signs and assemblies is
8 prohibited.

9
10 The VMS housing, structural framing, face covering, and mounting members shall
11 be designed to withstand a wind velocity of 100 mph with a 30 percent gust factor
12 and shall otherwise comply with the latest requirements of AASHTO's *Standard*
13 *Specifications for Structural Supports for Highway Signs, Luminaires and Traffic*
14 *Signals*.

15
16
17 8-20.2.OPT8(B).ITS.DT1

18 **(NWR ITS September 26, 2005)**

19 **Ground-mounted VMS Field Cabinet**

20 The field cabinet shall contain the equipment shown in the Plans. The cabinet shall
21 have the same external dimensions and appearance of Model 334 cabinets as
22 specified in Chapter 12 of FHWA IP-78-16. The cabinet shall contain the main
23 power feed from the 120/240v transformer.

- 24
25 1. Cabinets shall be fabricated of 0.125 inches sheet aluminum, 5052 alloy,
26 with mill finish, in accordance with Section 9-29.13(7)D, Item number 1.
27 Painted or anodized aluminum is not allowed.
28
29 2. Cabinet doors shall have a three-point latch and two-position stop
30 assembly with spring-loaded construction core lock capable of accepting a
31 Best Lock Company 6-pin CX series core. The Contractor shall supply
32 green construction cores with two master keys and one core removal key
33 per lock. The Contractor shall deliver the keys to the Engineer.
34
35 3. The cabinet shall be equipped with an electric strip heater and a
36 ventilation fan. The strip heater shall be rated at 100 watts and 120 VAC
37 and be shielded in a manner that prevents damage to nearby electrical
38 cables. The ventilation fan shall be mounted in the top of the cabinet, be
39 equipped with a screened guard, and exhaust at least 10 CFM.
40
41 The fan and strip heater shall be controlled by a high-low adjustable
42 thermostat, which can be set to ensure the cabinet interior temperature
43 remains between 60°F and 120°F.
44
45 4. Two shatterproof fluorescent interior cabinet lights with self-starting ballast
46 shall be furnished, one fixture mounted on the rear rack near the top and
47 the second mounted at the top of the front rack. Door switches shall
48 automatically turn on both lights when either door is opened.
49
50 5. The cabinet shall be provided with two 15 amp, 120 VAC duplex
51 receptacles. One of the receptacles is for a laptop and/or tools and shall

1 be GFCI-protected. The second receptacle is for communications
2 equipment and shall not be GFCI-protected.
3

- 4 6. The cabinet shall be provided with three (3) circuit breakers. One circuit
5 breaker shall be rated at least 20 amps and shall operate the heater,
6 ventilation fan, receptacles, and lamps. The second circuit breaker shall
7 be two-pole and control the power to the VMS defog/defrost heater
8 elements. The third circuit breaker shall operate all other sign equipment.
9 The second and third circuit breakers shall be rated in accordance with
10 the NEC. Separate terminal strips shall be provided for each circuit
11 breaker and an unfused terminal for the neutral side of the power supply
12 line.

- 13
14 7. The cabinet shall contain one VMS sign controller as specified under **VMS**
15 **Sign Controller**. The cabinet shall be provided with two serial
16 communication ports.
17

18 One communication port shall be used to connect a laptop to the
19 controller. The interface shall be wired as a 9-pin, EIA-232 DCE port. The
20 port shall connect to a laptop computer using a straight-through 9-pin
21 cable. One cable shall be supplied for each VMS installed in this contract.
22

23 The second communication port is for remote control of the sign from the
24 central computer. The interface shall be wired as a 25-pin, EIA-232 DTE
25 port. This port connects to a communication interface (modem) specified
26 elsewhere in this contract. A cable shall be supplied to connect the VMS
27 communication port to the modem port (the modem port may be a non-
28 standard pin-out and require a custom-made cable).
29

30 A reset button shall be provided in the cabinet that, when pressed, resets
31 the VMS controller and all other VMS electronics.
32

- 33 8. A pullout shelf shall be provided in the cabinet to facilitate a laptop during
34 local testing and control of the VMS.
35

- 36 9. Noise and voltage spike protection shall be provided in the cabinet as
37 stated in the Transient Current Protection section of the Contract
38 Provisions.
39

- 40 10. The conductor within the cabinet and the sign shall meet the requirements
41 of Section 9-29.24. The conductors for communication shall be a
42 minimum of 22 gauge.
43

44 8-20.2.OPT8(C).ITS.DT1

45 **(NWR ITS September 26, 2005)**

46 **Control System**

47 The VMS control system shall include all excavation, backfill, conduit, wiring, and
48 all hardware associated with providing power and communication between the local
49 control cabinet and the sign. It shall also include writing, providing, and installing all
50 software and any needed hardware to ensure the VMS is fully compatible with and
51 completely capable of being operated by the Contracting Agency's existing Digital

VAX computer system, while requiring no additional software or software modifications to be installed in the Contracting Agency's VAX.

Circuit Boards

The manufacturer's submittal shall include a schematic diagram for each type of circuit board used in the sign display and control system. Each circuit board used in the VMS display and control system shall conform to the following:

1. The printed circuit board through-hole for each LED cathode lead shall be connected to a large copper trace pad having a minimum surface area of 0.04 square inch. The trace pads shall dissipate heat from the LEDs and shall be present on both the front and rear sides of the LED pixel board.
2. All exposed metal (except connectors) shall be protected from water and humidity exposure by a thorough application of acrylic conformal coating. Bench level repairs to individual devices, including discrete LED replacement and conformal coating repairs, shall be possible.
3. Printed circuit laminate shall be FR-4 fiberglass, having a minimum thickness of 1/16 inch. The circuit board traces shall be copper. Through-holes shall also be plated with copper.
4. All cables attaching to circuit boards shall be held in place by locking latch connectors that firmly hold the cables in place.

Display LEDs

LEDs used in the VMS display shall be from one LED manufacturer and of one part number. LEDs shall conform to the following minimum requirements:

1. LEDs shall be un-tinted, non-diffused, high-output, solid state lamps utilizing Indium Gallium Aluminum Phosphide (InGaAlP) technology. The LED manufacturer shall be Toshiba or Hewlett-Packard.
2. The discrete LEDs size shall be T 1-3/4. LED package style shall be the through-hole flush-mount type, and all LEDs shall be soldered with the base of their lens mounted within 0.010 inches of the printed circuit board.
3. LEDs shall emit amber light, having a peak wavelength of 590 ± 5 nanometers. The half-life rating shall be 100,000 hours. Rated brightness per LED shall be a minimum of three (3) candelas.
4. LEDs shall be pre-sorted by the LED manufacturer for luminous intensity and color. LEDs used shall be obtained from a one-bin luminous intensity sort. A bin is defined such that when all LEDs from a given bin are driven with an identical forward current, the dimmest LED shall emit no less than half the luminous intensity of the brightest LED in the bin.
5. Operating temperature range shall be -22 to +185° F, and storage temperature range shall be -40 to +248° F.
6. Minimum half-power viewing angle shall be 15°. Half-power viewing angle is defined such that, at a given distance from the LED, luminous intensity

1 measured at any point at an angle of 7.5° from the LEDs center axis shall
2 be no less than half the luminous intensity measured directly on the LEDs
3 center axis.
4

- 5 7. The discrete LED manufacturer's data sheet showing compliance with this
6 Special Provision, and 10 samples, shall be provided with the VMS
7 manufacturer's submittal.
8

9 **LED Modules**

10 The VMS shall be constructed with multiple display circuit boards, each of which
11 contains no less than five (5), but no more than forty-five (45) pixels. Each pixel,
12 which is defined as the smallest programmable portion of a display matrix, shall
13 consist of a cluster of closely spaced discrete LEDs (strings of LEDs) and shall
14 conform to the following requirements:
15

- 16 1. The distance from the center of one pixel to the center of all adjacent
17 pixels, both horizontally and vertically, shall be 66.0 millimeters.
18
19 2. Each LED string shall be in series with its own current limiting resistor.
20 Current limiting resistors shall be rated to limit LED string forward current
21 to 30 milliamperes whenever a forward voltage is applied.
22
23 3. Each pixel shall contain a minimum two (2) string of LEDs. Each LED
24 string shall contain a minimum six (6) LEDs.
25
26 4. The failure of an LED string shall not cause a change in the forward
27 current of any other LED string, nor shall it cause the failure of any other
28 LED string. Similarly, the failure of any LED pixel shall not cause the
29 failure of any other pixel in the VMS.
30
31 5. Each LED pixel shall emit a minimum luminous intensity of 40 candelas
32 when driven with a forward current of 20 milliamperes DC per LED string.
33 An independent laboratory that utilizes equipment and procedures
34 traceable to N.I.S.T. standards shall certify LED pixel intensity. The
35 independent laboratory's certification report shall be provided with the
36 VMS manufacturer's submittal. This report shall contain the laboratory
37 name, address, and contact information. The report shall also contain a
38 description of the test procedure and test equipment used, test personnel
39 name(s), pixel intensity test results, date(s) the VMS manufacturer's LED
40 pixel samples were tested, and the VMS manufacturer's name.
41
42 6. Discrete LEDs shall be mounted perpendicular to their PC boards. Any
43 variations in discrete LED color and intensity shall be thoroughly
44 dispersed throughout the entire display, thereby creating a uniform visual
45 appearance of both color and intensity.
46
47 7. The sign controller shall be able to measure the forward current of each
48 LED pixel and determine if the pixel is operating normally. This
49 information shall be stored in a read-only NTCIP object.
50

LED Output Control

The LEDs shall be driven using Pulse Width Modulation (PWM) of a nominal 30 milliampere forward current, where pulse width is used to achieve the programmed LED intensity level for a given ambient lighting condition.

The current pulse shall be modulated from a 10-millisecond period, and pulse amplitude shall not be allowed to exceed 30 milliamperes per LED string. An illustration of the PWM drive current waveforms, which are used to achieve minimum and maximum LED intensity, shall also be provided with the VMS manufacturer's submittal.

LED Intensity Control System

The VMS shall be equipped with an LED intensity control system. The control shall support both manual and automatic control. LED intensity control shall consist of three (3) photo-sensors and associated circuitry. VMS controller analysis of these ambient light measurements shall automatically determine which of sixteen pre-programmed LED intensity levels will provide the best VMS legibility for the given ambient light condition. The LED intensity control system shall not cause flickering of the LED display.

The LED intensity control system shall conform to the following minimum requirements:

1. The VMS controller shall contain a read-write NTCIP object that adjusts the maximum usable intensity threshold, the Maximum Pulse Width Modulation (MPWM). This number is a percentage of the absolute maximum possible intensity. At the time of VMS delivery, MPWM shall be set to 67%. The LED intensity control system shall be designed such that a MPWM value of 100% delivers a time-average current of 30 milliamperes, and the MPWM value of 67% delivers a time-average current of 20 milliamperes.
2. Automatic intensity control shall select one of sixteen LED intensity levels based on the sensed ambient light. The threshold points for each intensity levels shall be user programmable. LED intensity levels shall be available in 1% increments and in a range of 1% to 100% of maximum display intensity.

LED Display Driver Circuit Boards

The VMS shall contain 9x5 LED display modules, which are constructed as follows:

1. LED pixel circuit boards shall be mounted to the back of an aluminum panel to form a 9 pixel high by 5 pixel wide LED display module. The pixel board(s) shall be mounted to the aluminum panel with durable, non-corrosive fasteners, and their removal from the panel shall not require use of tools.
2. One electronic driver circuit board shall be provided for each 9 high by 5 wide (9x5) LED pixel module and shall individually control all 45 pixels on that module.

3. Failure of a 9x5 driver board shall not cause the failure of any other 9x5 LED display module.
4. The LED display shall have a minimum refresh rate of 100 frames per second. The VMS manufacturer's submittal shall provide calculations that prove that the display conforms to this requirement.
5. The aluminum module panel shall have a minimum thickness of 1.5 millimeters, and it shall contain a circular opening for each LED pixel. The openings shall be sized so they do not block any portion of the 15° LED viewing cone.
6. The front side of the aluminum module panel, which faces the viewing motorists, shall be primed and coated with flat black paint.
7. Display modules and all of their components shall be easily replaceable from inside the VMS housing. Display modules shall mount securely to a support frame located inside the sign housing using durable, non-corrosive hardware. Module removal and replacement shall be accomplished with the use of simple hand tools or no tools.
8. All display module electrical connections shall be the quick-disconnect locking connector type. Removal of a 9x5 display module from the VMS, or a pixel board or driver board from its display module, shall not require a soldering operation.

Power Supplies

The LED display matrix shall be powered by regulated switching DC power supplies that operate from 120 VAC input power and have an output of 24 volts DC or less. Power supplies shall be wired in a redundant parallel configuration that uses multiple supplies per display. The supplies shall have a "current sharing" capability, that allows them to provide equal amounts of current to their portion of the LED display. Power supplies shall be rated such that if one supply fails, the remaining supplies will be able to operate their portion of the display under full load conditions (all pixels on at maximum drive current) while in an ambient temperature of +140° F.

Power supplies shall operate within a minimum input voltage range of +90 to +135 volts AC. Power supply output at an ambient temperature of +140° F shall be no less than 65% of its room temperature (+70° F) output. Power supply efficiency shall be a minimum of 74%. Power supplies shall have a minimum power factor rating of 0.95. Power supplies shall be short circuit protected. Under short circuit conditions, the DC side of the power supply shall be powered down. The power supplies shall reset automatically after 5 seconds of AC power off. Power supplies shall be protected by a minimum overload allowance of 105%. Inputs to power supplies shall be fused or circuit breaker protected. A failed power supply shall not interfere with the other operating power supplies.

The VMS sign controller shall be capable of monitoring the operational status ("normal" or "failed") of each individual power supply by reading a diagnostic signal located on the supply's DC output.

1 A copy of the power supply manufacturer's data sheet and its UL product card shall
2 be provided with the VMS manufacturer's submittal.

3
4 The VMS manufacturer's submittal shall contain calculations demonstrating that the
5 power supplies are rated for the criteria in this Special Provision. These
6 calculations shall account for power supply output de-rating at a temperature of
7 +140° F.

8 9 **Transient Current Protection**

10 VMS and sign controller signal and power inputs shall be protected from electrical
11 spikes and transients.

12
13 AC power for all equipment shall be protected at the load center inside the field
14 cabinet. A parallel-connection surge suppresser, rated for a minimum surge of 10
15 kJ, shall be connected to the load center in a manner that protects the load center
16 and the equipment it feeds.

17
18 AC power for control equipment, such as the field controller and modem, shall be
19 further protected by the use of a series-connected surge suppresser capable of
20 passing 15 Amps of current. This device shall be UL 1149 recognized.

21
22 EIA 232/485 communication ports in the sign controller shall be protected by
23 avalanche diodes rated for 11.5 Volts at 10 Amps and 14 Volts at 70 Amps. The
24 diodes shall be and connected between each signal line and ground.

25
26 Digital input and output lines from the VMS to the control equipment shall be
27 protected at the control equipment by optically isolated input and output modules,
28 or optically-isolated solid state relays. Inputs shall include, but shall not be limited
29 to the VMS regulated power supply diagnostics and the AC power failure alarm.
30 Outputs shall include, but shall not be limited the cooling fan and defog/defrost fan
31 control.

32 33 **VMS Sign Controller**

34 Each VMS shall include an associated sign controller, which shall be installed in the
35 field cabinet. The sign controller hardware and software shall support all VMS
36 communication, control, and diagnostic features as listed herein.

37 38 **Memory**

39 Sign controllers shall have both permanent and semi-permanent memory.
40 Permanent memory shall be EE-PROM integrated circuits and shall contain the
41 executable sign controller software. Semi-permanent memory shall be RAM
42 integrated circuits with a battery backup that retains the data in memory for a
43 minimum of one year following a power failure. Semi-permanent memory shall
44 contain the library of messages, the message display schedule and programmable
45 operating parameters. Each message shall have the capability to be defined and
46 stored as a three-page message.

47 48 **Power Interruptions**

49 Contents of the sign controller's memory shall be preserved by battery backup
50 during AC power interruptions and the controller shall automatically resume
51 operation once AC power is restored. Upon recovering from a power interruption,
52 the sign controller shall display the message identified by the Power Recovery

1 Message parameter. The sign controller shall report to the central computer that it
2 has recovered from a power interruption.
3

4 8-20.2.OPT8(D).ITS.DT1
5 **(NWR ITS February 11, 2002)**
6 **Sign Controller Software**
7 The sign controller shall cause the desired message to be displayed on the VMS.
8 The sign shall display alphanumeric character fonts. The sign controller shall
9 provide a default value for each NTCIP object supported.
10

11 **Message Selection**
12 The central computer or laptop computer shall cause the sign controller to
13 implement a message selected from those stored in controller memory, or a new
14 message entered via the communication port.
15

16 The sign controller shall incorporate CRC checks to verify MULTI strings. The sign
17 shall not display a message unless the MessageActivationCode CRC matches the
18 MessageCRC.
19

20 A message shall remain displayed on the sign until either a command to change
21 the current message or a command to blank the display is received. A command to
22 display a message shall not succeed if the activation priority is less than the run
23 time priority of the message currently displayed.
24

25 **Data Transmission Requirements**
26 Each sign controller shall contain two communication ports. Each communication
27 port shall be labeled ("Local" or "Central") and shall be set to 9600 baud at the
28 factory. Each port shall operate independently at baud rates of 1200, 2400, 9600,
29 and 19,200 bits per second. The user shall select the baud rate for each port via a
30 DIP switch.
31

32 **Communication**
33 The sign controller hardware and software shall communicate with the central
34 computer in a polled multi-drop operation. In the polled multi-drop operation,
35 several sign controllers shall share the same communication channel, with each
36 controller assigned a unique ID number. Controller ID numbers shall conform to
37 the NTCIP requirements for address numbers. A sign controller shall only reply to
38 messages labeled with its ID. In polled multi-drop mode, sign controllers never
39 initiate communication, but merely transmit their responses to messages from the
40 central computer.
41

42 A laptop computer connected to the sign controller's local communication port shall
43 have the same control and diagnostic capabilities as the central computer.
44 However, local laptop control capability shall be limited to the VMS which is directly
45 connected to that sign controller.
46

47 **NTCIP Requirements**
48 The sign controller software shall comply with the National Transportation
49 Communications for ITS Protocol (NTCIP) documents and all related errata sheets
50 published before July 1, 1999 and as referenced herein.
51

52 The sign controller software shall support the following standards:

1. NTCIP 1101, *Simple Transportation Management Framework (STMF)*, Conformance Level 1 (Simple Network Management Protocol (SNMP))
2. NTCIP 2001, *Class B Profile*. All serial ports on the device shall support communications according to these standards.
3. NTCIP 2101, *SP-PMPP/RS232* Point-to-Multi-Point Protocol (PMPP)
4. NTCIP 2201, *NTCIP TP-Null* Transport Profile Null (TP-NULL)

The sign controller software shall implement all mandatory objects of all mandatory conformance groups as defined in NTCIP 1201, *Global Object Definitions*, and NTCIP 1203, *Object Definitions for Dynamic Message Signs*. Software shall implement the following conformance groups:

NTCIP 1203, Object Definitions for DMS

1. VMS Sign Configuration
2. MULTI Configuration
3. Default Message Control
4. Pixel Service Control
5. MULTI Error Control
6. Sign Status
7. Status Error
8. Pixel Error Status
9. Lamp Error Status
10. Fan Error Status
11. Power Status
12. Temperature Status

The software shall implement the following optional objects:

NTCIP 1203, Object Definitions for DMS

1. dmsMessageBeacon
2. dmsMessagePixelService
3. dmsCommunicationsLossMessage
4. dmsPowerLossMessage
5. dmsTimeCommLoss
6. dmsMultiOtherErrorDescription
7. dmsStatDoorOpen
8. fanFailures
9. fanTestActivation
10. lineVolts
11. tempMaxSignHousing

Objects required by these specifications shall support all values within its standardized range. The standardized range is defined by a size, range, or enumerated listing indicated in the object's SYNTAX field and/or through descriptive text in the object's description field. The following list indicates the modified object requirements for these objects.

Object Name	Object ID	Minimum Requirements
Number of Fonts	numFonts	9
Maximum Characters per Font	maxFontCharacters	255
Default Background Color	defaultBackgroundColor	0
Default Foreground Color	defaultForegroundColor	9
Default Justification Line	defaultJustificationLine	2, 3, and 4
Default Justification Page	defaultJustificationPage	2, 3, and 4
Number of Permanent Msgs.	DmsNumPermanentMsg.	2
Maximum No. Changeable Msg.	DmsMaxChangeableMsg.	8
Maximum Number Volatile Msg. *	dmsMaxVolatileMsg.	8
Control Mode	dmsControlMode	2, 4, and 5

* Changeable messages in excess of the minimum requirement are considered to meet the specification for an equivalent number of Volatile messages.

The first permanent message shall be used to blank the sign display. The second permanent message shall be the diagnostic message.

Sign controller software shall implement the following tags (opening and closing where defined) of the Mark-Up Language for Transportation Information (MULTI) as defined in NTCIP 1203:

1. Flash
2. Font
3. Justification Line
4. Justification Page
5. Moving Text
6. New Line
7. New Page
8. Page Time

Documentation

Software shall be supplied with all documentation on 1.44Mb IBM-compatible diskette(s). ASCII versions of the following Management Information Base (MIB) files in Abstract Syntax Notation 1 (ASN.1) format shall be provided on CD-ROM:

1. The official MIB Module referenced by the device functionality.
2. A manufacturer-specific version of the official MIB Module with the non-standardized range indicated in the SYNTAX field. The filename shall match the official MIB Module, with the extension "spc".

- 1
2
3 3. A MIB Module of all manufacturer-specific objects supported by the device
4 with accurate and meaningful DESCRIPTION fields and the supported
5 ranges indicated in the SYNTAX field.

6
Control Software

7 This work shall consist of furnishing Variable Message Sign (VMS) control software.
8 The control software shall be a 32-bit application, designed to operate on
9 Microsoft® Windows NT™, 98™, or 2000™ operating system. The control software
10 shall provide for command and control of the following functions:

11
12 **VMS Control**

13 Software shall retrieve, display, update and download/upload the following
14 functional parameters to the local sign controller in response to user-initiated
15 instructions. The sign controller shall not perform pixel service tests when VMS are
16 displaying messages. Software shall perform the following operations in
17 conjunction with its monitoring and logging functions:

18
19 Display a message
20 Blank the current message
21 Change message priority
22 Pixel service, lamp and fan tests
23 Set time and date in the sign controller
24 Retrieve sign controller ID, type, and manufacturer
25

26
Communications

27 Communications between the control software and sign controller shall be NTCIP
28 compliant, as indicated in the Special Provision for Variable Message Sign System.
29

30 The control software shall verify all communications for errors. If a response from a
31 sign controller contains a communication error, or if there is no response, the
32 Control Software shall re-establish communications.
33

34
Data Collection

35 The control software shall retrieve errors detected, message number currently
36 being displayed, and current message priority. Using different commands, the
37 software shall retrieve message MULTI strings, a map of defective pixels, the time
38 and date, the event schedule, and configuration parameters.
39

40
Message Library

41 The control software shall store messages and transfer messages to a sign for
42 storage and/or display. When a user desires to send a message to a sign, the
43 control software shall offer as choices only those messages compatible with the
44 sign in question. The control software shall allow message names of up to 25
45 characters in length. If the selected name already exists, the software shall notify
46 the user and give the option of replacing the existing message or selecting another
47 name.
48

49 The control software shall display all character fonts supported by the Variable
50 Message Sign System. Messages shall be displayed on the computer monitor in
51 exactly the same format (font, text centering and justification) as on the Variable
52 Message Sign.

1
2 **Software Duplication Rights**

3 The Department shall have the right to duplicate the Variable Message Sign Control
4 Software as needed for use in controlling signs under its jurisdiction.
5

6 **Documentation**

7 The Contractor shall furnish five (5) copies of the Control Software user manuals to
8 the Engineer. In addition, three (3) sets of the software, installation program,
9 instructions and user manual shall be furnished on CD ROM or diskettes to the
10 Engineer.
11

12 8-20.2.OPT13.ITS.DT1

13 ***Highway Advisory Radio (HAR) System***

14
15 8-20.2.OPT13(A).ITS.DT1

16 **(NWR ITS October 16, 2006)**

17 **Highway Advisory Radio Transmitter (HART)**

18 Each HART shall be a Black Max HAR AM Broadcast System, manufactured by
19 Highway Information Systems, Inc. The HAR system shall include the following
20 components:
21

22 1. Equipment Model Numbers:

23
24 Electronics Rack RCK0001
25 AM Transmitter Module DRTXM3
26 Digital Recorder Module DR1500AM
27 Digital Communications Controller Module DCC-1
28 Power Supply Module DRPSM1
29 Antenna ANT1000
30 Ground Plane GND0001
31

32 2. Manufacturer Information:

33
34 Highway Information Systems, Inc.
35 4021 Stirrup Creek Dr
36 Suite 100
37 Durham, NC 27703
38 Telephone: 1-800-849-4447
39 www.highwayinfo.com
40

41 3. Equipment Descriptions:

42
43 **Amplitude Modulated (AM) Transmitter Module**

44 The amplitude modulated transmitter module shall be of a FCC-accepted
45 type and operate on a frequency of *** \$1\$\$ **. The transmitter module
46 shall be installed in a RCK0001 equipment rack.
47

48 **Digital Recorder Module**

49 The digital recorder module records and plays back human voice
50 messages by the use of a solid-state memory. The module shall be
51 installed in a RCK0001 equipment rack.
52

Digital Communications Controller Module

The digital communications controller module allows the user to control the HART using touch-tone telephone, various serial interfaces, and ethernet. The module shall be installed in a RCK0001 equipment rack.

Antenna

The antenna system shall match the transmitter frequency. The antenna shall be such that it can be tuned to resonance at mounting heights between 25 and 30 feet above the ground. The antenna shall be rugged and able to withstand winds of up to 80 mph without ice buildup, and 50 mph with 1/2-inch of ice buildup.

The antenna shall be mounted on a wood pole as shown in the Plans with appropriate hardware.

The antenna system shall include the installation of a groundplane consistent with the manufacturer's recommendation. This ground plane shall be either the Triad Ground System (consisting of 6, 10 foot long perforated copper ground pipes buried 20 feet deep) or the Radial Ground System (consisting of 20 – 120 foot long 8 AWG copper radials buried 1 foot deep).

HART Cabinet

The HART Cabinet shall be a Model 334 Controller Cabinet meeting the requirements of the subsection **Fiber Optic Terminal Cabinets** of these specifications.

Communication Connection

Where twisted-pair cable is installed in the HART cabinet, the following shall be provided:

1. Type R66B, six-pair, six-position, quick-connect terminal block. Each block shall contain 12 rows with six clips each.

Type RJ11 jack.

Where fiber optic cable is installed in the HART cabinet, the following shall be provided:

1. Fiber Optic Ethernet switch (as identified in the Plans and specified in **Voice, Video and Data Distribution and Transmission Systems**)
2. Fiber Optic Distribution Panel (as identified in the Plans and specified in **Fiber Optic Distribution Panels**)

(*****)

Materials

Section 8-20.2 is supplemented with the following:

Flashing Beacons

Two 8-inch amber beacons with round visors shall be provided with each sign assembly. The signal display shall meet the requirements of Section 9-29.16. The flashing beacon control shall meet the requirements of Section 9-29.15. The beacons shall flash alternately. The flashing control shall be designed to be accessible from inside the cabinet.

Sign Lighting Luminaires

The sign lighting luminaires shall consist of standard sign lights in accordance with Standard Plan G-9 except for the shoulder mount sign, where the sign light shall be mounted on top. The Contractor shall include a top mount kit for the sign light for this location.

Model 334 Cabinet

Controller cabinet furnished shall meet the requirements specified in Chapter 6 of the Caltrans Traffic Signal Control Equipment Specifications (TSCES), January 1989, as currently amended except as modified by the following:

Cabinet Construction

1. Cabinets shall be fabricated of 0.125-inch sheet aluminum, 5052 alloy, with mill finish, in accordance with Section 9-29.13(7)D, Item number 1. Painted or anodized aluminum is not allowed.
2. A spring loaded construction core lock capable of accepting a Best 6-pin core shall be installed on all doors accessing WSDOT equipment. A 6-pin green construction core shall be installed in each core lock. Upon contract completion, two master keys for each cabinet shall be delivered to the Engineer.

Cabinet Ventilation and Heating

1. A 12 inch wide x 16 inch high x 1 inch thick disposable paper filter element shall be provided in lieu of a metal filter.
2. The cabinet shall be equipped with an electric strip heater with a rating of 100 watts and 120 VAC, and a ventilation fan meeting the requirements specified in Chapter 6 of Caltrans TSCES, 1989. The strip heater shall be shielded in a manner that prevents damage to nearby electrical cables.
3. The fan and strip heater shall be controlled by a high-low adjustable thermostat that can be set to ensure the cabinet interior temperature remains between 60°F and 125°F

Cabinet Accessories

The Contractor shall provide all cabinet accessories, including:

1. Two shatterproof fluorescent interior cabinet lights with self-starting ballast shall be furnished, one fixture mounted on the rear rack near the top and

the second mounted at the top of the front rack. Door switches shall automatically turn on both lights when either door is opened.

2. One controller unit shelf, which attaches to the front rails of the EIA rack, shall be provided in lieu of the two controller unit support angles. The shelf shall be fabricated from aluminum and shall be installed such that it does not interfere with access to any terminal block. The shelf shall contain a roll-out flip-top drawer for storage of wiring diagrams and manuals.
3. Each Model 334 cabinet shall be equipped with a fully operable Type 170E controller equipped as specified in these Special Provisions.
4. A transient voltage protection device shall be provided, which plugs into the controller unit receptacle and in turn accepts the controller plug and meets the electrical requirements of Section 9-29.13(7)B(3)e.
5. The cabinet shall be equipped with a power distribution panel mounted in a standard EIA 19-inch (ANSI/EIA RS-310-C) rack utilizing no more than five rack-mounting spaces (8.75 inches). The following devices shall be provided with the power distribution panel:
 - a. Duplex 120 VAC power receptacle.
 - b. Main circuit breaker, 120 VAC, 20 amp.
 - c. Four load circuit breakers, 120 VAC, 15 amp.
 - d. Neutral bus
 - e. Ground Bus
 - f. Surge suppresser and filter unit 120 VAC, 50 amp.

The ground bus, neutral bus, and surge suppresser and filter unit shall be mounted on the right rear cabinet panel. All other power distribution panel components shall be mounted in or on the panel such that they are readily accessible, provide dead front safety, and all hazardous voltage points are covered to prevent inadvertent contact.

6. Each Cabinet shall be furnished with a mounting panel. The mounting panel shall be fabricated from aluminum and shall be 19 inches wide by 10.5 inches tall.
7. The mounting panel shall be equipped with one HAR sign control switch with labels and functions as follows:

AUTOMATIC

Flashing Beacons shall energize upon ground true call from controller.

SIGN OFF

Flashing Beacons shall de-energize.

SIGN ON

Flashing Beacons shall energize.

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50

- 8. The sign relay shall be plugged into a socket installed on the rear of the mounting panel. The relay shall be wired as shown in the Plans. The relay coil shall draw (or sink) less than 50 milliamperes from the 170E controller and have a DPDT contact rating not less than 10 amperes. A 1N4004 diode shall be placed across the relay coil to suppress voltage spikes.
- 9. The Contractor shall install the C1 connector according to the pin assignments shown in the Plans.
- 10. One reproducible drafting film and two non-fading copies of the cabinet wiring diagram shall be furnished with each cabinet.
- 11. Each HAR sign cabinet shall be supplied with one Model 204 sign flasher unit mounted on the right rear side panel.

Cabinet Wiring

- 1. Cabinet wiring shall conform to the details and diagrams in the Plans. The Contractor shall trim wiring to eliminate all slack and lace or bind together with nylon wraps or equal. All terminals shall be labeled. The cabinet shall be wired completely so that the only requirement to make a field location completely operational is to connect field, power and ground wires to appropriate terminals.
- 2. Terminal block TB1 shall be installed in the cabinet.

Terminals for field wiring shall be labeled, numbered and connected in accordance with the following:

<u>Terminal Block Pos</u>	<u>Terminal and Wire Numbers</u>	<u>Connection Identification</u>
TBS	501-502	AC Power, Neutral
TB1-1	644	Flasher Output NC
TB1-2	645	Flasher Output NO
TB1-3		Future Neutral

Model 170E Controller

Each HAR sign controller unit furnished shall meet the requirements specified in Chapter 2 of the Caltrans Transportation Electrical Equipment Specification (TEES), August 2002, as currently amended and modified as follows:

- 1. The 170E CPU module shall operate a 68HC11F1 MPU at a crystal frequency of 8MHz. The MPU shall be socket mounted in a PLCC socket.
- 2. The EPROM shall be resident on the CPU module. The EPROM socket shall be a 32-pin lever-controlled ZIF device. The EPROM shall be either a 32K x 8 or a 128K x 8 device. The device size shall be jumper selectable.

- 1 3. Feature and Location switches shall be provided on the front portion of the
2 CPU module. Each switch shall be an 8-position front-reading dip switch. The
3 switches shall be addressed as follows:
4
5 Location Switch at 7000 (Port A)
6 Feature Switch at 700A (Port E)
7
- 8 4. There shall be one LED indicator located on the front of the CPU module. This
9 LED shall be connected to bit 3 of Port G.
10
- 11 5. The 170E controller shall have a minimum of 28 kB of battery backed static
12 RAM on the CPU module. RAM shall be continuous from location 0000 to
13 6FFF.
14
- 15 6. Four Asynchronous Communication Interface Adapters (ACIAs) shall be
16 provided on the same board as the CPU. The ACIAs shall be 6850 ICs
17 operating at a crystal frequency of 6.144MHz. Each ACIA shall have 5
18 programmable jumpers to select 5 communication baud rates (1200, 2400,
19 4800, 9600, 19200) for a total of 20 jumpers. All ACIAs shall be active. An
20 IRQ status register shall be provided at 75FF.
21
- 22 7. The Model 412C PROM module shall not be provided. A blank panel shall
23 cover the PROM slot.
24
- 25 8. Two blank 27256 EPROM chips shall be provided with the CPU module.
26
- 27 8-20.2.OPT13(B)1.ITS.DT1
28 (NWR ITS February 11, 2002)
29 10. Each 170E controller shall include a Model 400 modem.
30
- 31 8-20.2.OPT13(B)2.ITS.DT1
32 (NWR ITS February 11, 2002)
33 10. Each 170E controller shall include a drop/insert data modem.
34
- 35 8-20.2.OPT13(B)3.ITS.DT1
36 (NWR ITS February 23, 2009)
37 10. Each 170E controller shall include an unmanaged ethernet switch and a
38 cabinet device server.
39
- 40 8-20.2.OPT14.ITS.DT1
41 **Communication Conduit System**
42
- 43 8-20.2.OPT14(A).ITS.docx
44 (*****)
45 **4 inch PVC Schedule 40 and Schedule 80 Conduit With Innerduct**
46 Conduit shall be supplied as a system from a single manufacturer providing all of
47 the steel and PVC conduit; all required fittings, terminations, and other installation
48 accessories; all in accordance with the Plans, the Standard Specifications and
49 these Special Provisions. The conduit shall be free from defects, including non-
50 circularity, foreign inclusions, etc. It shall be uniform in color, density, and physical
51 properties. It shall be straight and the ends shall be cut square to the inside
52 diameter. All conduit shall display the Underwriters Laboratory certification (UL

Listed). All conduit shall continue to meet the requirements of Section 9-29.1 unless specified otherwise herein.

8-20.2.OPT14(B).ITS.DT1

(NWR ITS January 30, 2003)

Flexible bends shall be supplied in the minimum lengths necessary to meet field requirements.

8-20.2.OPT14(C).ITS.DT1

(NWR ITS March 22, 2004)

Location Wire and Warning Tape

Warning Tape

Warning tape shall be polyethylene. The polyethylene shall have a minimum 4 mil thickness and be 3 inch wide. The polyethylene shall be orange in color and printed in black with the words "Fiber Optic Cable Buried Below."

Location Wire

Location wire shall be #14 AWG THWN or XHHW orange-colored wire.

8-20.2.OPT14(D).ITS.DT1

(NWR ITS March 22, 2004)

Cable Vaults and Pull Boxes

Cable vaults and pull boxes shall meet AASHTO M-199, H-20 or H-35 loading requirements. Cable vaults and pull boxes installed in paved shoulders or lanes that will be subjected to vehicular traffic during any phase of this contract or as specified in the Plans shall meet H-35 loading requirements. Cable vaults and pull boxes shall be fabricated in accordance with ASTM C857-83 and C858-83. All cable vaults and pull boxes shall include the following provisions:

1. A sump 6 inches in diameter by 2 inches in depth with a 1-inch diameter drain hole in the center of the sump.
2. Cable pulling irons positioned to afford bi-directional cable installation through the cable vault or pull box.
3. Factory installed knock-outs for conduit entry.
4. All cable racking hardware shall be stainless steel.
5. Cable vaults meeting H-20 requirements shall have a hinged and spring-assisted double steel plate cover. Cable vaults and pull boxes meeting H-35 requirements shall have round cast iron lids. Pull boxes meeting H-20 requirements shall have a hinged, single plate cover. All cable vault and pull box covers shall be marked with ITS legend according to Standard Plan J-11a.

Above ground pull boxes shall be a minimum 16 inches wide, 16 inches high and 8 inches deep, unless otherwise specified in the Plans. Above-ground boxes shall be fabricated in accordance with NEMA 4X designation for stainless steel enclosures. Pull boxes shall be equipped with a removable front panel for access to all conduits. The front panel shall be hinged and the entire pull box shall be fabricated from stainless steel.

8-20.2.OPT18.ITS.DT1

Communication Cables And Interfaces

8-20.2.OPT18(A).ITS.DT1

(NWR ITS October 16, 2006)

Fiber Optic Distribution Panels

The fiber optic distribution panel shall be rated by the manufacturer as a fiber optic distribution panel. The distribution panel shall be designed to hold, at a minimum, the specified number of interconnection sleeves and splice trays. The splice trays and the fiber optic interconnection sleeves shall be fully enclosed on all sides by the distribution panel when the distribution panel is closed.

Each distribution panel shall be fully populated with interconnection sleeves. Interconnection sleeves shall contain zirconium (ceramic) linings (phosphorus bronze is not allowed). All unutilized interconnection sleeves shall have protective dust covers installed.

The distribution panels shall be EIA 19-inch (ANSI/EIA RS-310-C) rack-mountable, unless otherwise noted.

Mounting plates for interconnection sleeves shall be constructed of metal. Adequate spacing shall be provided around each interconnection sleeve. Where interconnection sleeves are arranged in a vertical line, the minimum horizontal center-to-center spacing shall be 1.25 inches (31mm), and the minimum vertical center-to-center spacing shall be 0.625 inches (16mm). Where interconnection sleeves are arranged in a staggered layout, the minimum center-to-center radial distance between sleeves shall be 0.875 inches (22mm).

A wiring diagram shall be supplied with each distribution panel. The wiring diagram shall identify each fiber terminated in the distribution panel using the fiber optic cable labeling method as specified later in these provisions. The wiring diagram shall be placed in a plastic sheet protector next to the distribution panel.

8-20.2.OPT18(B).ITS.DT1

(NWR ITS October 16, 2006)

Wall Mounted Fiber Optic Distribution Panel

The fiber optic distribution panel shall be designed to hold a minimum of 6 FC fiber optic interconnection sleeves and splice trays with 12-splice capacity. The distribution panel shall allow for full access to the splice trays and both sides of the fiber optic interconnection sleeves from the front of the distribution panel. The distribution panel shall not exceed 6 inches width, 7.5 inches in height and 2 inches in depth (not 19-inch rack-mountable).

8-20.2.OPT18(C).ITS.DT1

(NWR ITS October 16, 2006)

Small Cabinet Fiber Optic Distribution Panel

The fiber optic distribution panel shall be designed to hold a minimum of 12 FC fiber optic interconnection sleeves and splice trays with 12-splice capacity. The distribution panel shall allow for full access to the splice trays and both sides of the fiber optic interconnection sleeves from the front of the distribution panel. The distribution panel shall not exceed 1 RMU (1.75 inches) in height.

8-20.2.OPT18(D).ITS.DT1

(NWR ITS October 16, 2006)

Cabinet Fiber Optic Distribution Panel

The fiber optic distribution panel shall be designed to hold a minimum of 36 FC fiber optic interconnection sleeves and splice trays with 48-splice capacity. The distribution panel shall allow for full access to the splice trays and both sides of the fiber optic interconnection sleeves from the front of the distribution panel. The distribution panel shall not exceed 3 RMU (5.25 inches) in height.

8-20.2.OPT18(E).ITS.DT1

(NWR ITS October 16, 2006)

Large Cabinet Fiber Optic Distribution Panel

The fiber optic distribution panel shall be designed to hold minimum of 48 FC fiber optic interconnection sleeves and splice trays with 72-splice capacity. The distribution panel shall allow for full access to the splice trays and both sides of the fiber optic interconnection sleeves from the front of the distribution panel. The distribution panel shall not exceed 4 RMU (7 inches) in height.

8-20.2.OPT18(F).ITS.docx

(***)**

Preterminated Patch Panel

A wiring diagram shall be supplied with each patch panel. The wiring diagram shall identify each fiber terminated in the distribution panel using the fiber optic cable labeling method as specified later in these provisions. The wiring diagram shall be placed in a plastic sheet protector next to the distribution panel.

The Contractor shall provide, install and connect preterminated patch panels as shown in the Plans. The panels shall be manufactured by ADC Telecommunications, Inc. Outside plant cable meeting ITU G652.D and G694.2 shall be utilized for the stubs on all preterminated patch panels and the Contractor shall confirm with the manufacturer that the length of each stub is sufficient for the needs at each location. All openings in the patch panels shall be plugged by the manufacturer. Connections shall be LC\UPC type and shall be terminated by the manufacturer.

1. Equipment Model Numbers (for use in cabinets):

Description	Part Numbers (Both parts are required)
12-Port Preterminated Patch Panel	ADC12LCUXXXMCD00, and FL2-ACC0071
24-Port Preterminated Patch Panel	ADC24LCUXXXMCD00, and FL2-ACC0072
48-Port Preterminated Patch Panel	FL2-T2804JXXX-CD00, and FL2-ACC0072
72-Port Preterminated Patch Panel	ADC72LCUXXXMCC00, and FL2-ACC0073
96-Port Preterminated Patch Panel	ADC96LCUXXXMCC00, and FL2-ACC0074

Equipment Model Numbers (For concrete or underground Hubs):

Description	Part Numbers (Both parts are required)
48-Port Preterminated Patch Panel	FL2-T2804JXXX-DB00, and FL2-ACC0072
72-Port Preterminated Patch Panel	ADC72LCUXXXMDU00, and FL2-ACC0073
96-Port Preterminated Patch Panel	ADC96LCUXXXMDU00, and FL2-ACC0074

Note: The stub length for each panel (XXX in the part number, in meters) shall be determined by the Contractor for each location and shall include 50 feet of slack in the cable vault.

2. Manufacturer Information:

ADC Telecommunications, Inc.
P.O. Box 1101
Minneapolis, MN 55440-1101.
Telephone: (800) 366-3891

8-20.2.OPT18(G).ITS.docx

(*****)

Fiber Optic Connector

Unless otherwise noted in the Plans, all fiber optic connectors used on this project shall meet the following:

All shall be LC/UPC (55dB) in accordance with Telcordia 6R-326
All shall be factory-connectorized

8-20.2.OPT18(H).ITS.DT1

(NWR ITS February 11, 2002)

Fiber Optic Cable Lubricant

Fiber optic cable lubricant shall be as follows:

Compatible with the cable jacket
Non-combustible
Water-based leaving little or no residue

8-20.2.OPT18(I).ITS.DT1

(NWR ITS February 11, 2002)

Fiber Optic Splice Closure

All fiber optic splice closures shall be re-enterable and reusable and be designed for use on fiber optic cables in an underground, submerged environment. All splice closures shall be rated for 1310 and 1550 nanometer wavelengths. Splice closures shall contain a valve to allow pressurization of the housing.

8-20.2.OPT18(J).ITS.DT1

(NWR ITS October 18, 2004)

Copper Cable Protector Block

Copper cable protector blocks shall have the following:

1. A combination connection/protector stubless, with bifurcated quick-clip terminals block for the protection and termination of an OSP cable.

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51

- 2. Twenty-five solid state type protector units, with gold pins, for the low voltage heat coil.
- 3. The Contractor shall provide the termination block one type R66B 25-pair stubless bifurcated quick clip terminal for each TWP cable and one for every three 6 TWP cables. One more shall be mounted on a backboard in the cabinet.
 - a. Each block shall contain 50 rows with six clips each.
 - b. Each row shall be clearly and permanently marked with the number of the cable pair which is attached.
 - c. Within each row the clips shall be electrically connected within the block so as to form two sets of three adjacent clips.

Copper Cable Termination Blocks

Copper cable termination block units shall have 25-pair bifurcated quick clip termination blocks.

8-20.2.OPT18(K).ITS.DT1
(NWR ITS September 26, 2005)
Terminal Cabinets

Terminal cabinets furnished for this contract shall be pad mounted and fabricated in accordance with Section 9-29.25 except:

- 1. Cabinets shall be fabricated of 0.125" sheet aluminum, 5052 alloy, with mill finish, in accordance with Section 9-29.13(7)D, Item number 1. Painted or anodized aluminum is not allowed.
- 2. Cabinet doors shall be two-hinged with neoprene gasket and provided with a three-point latch and two-position stop assembly with spring loaded construction core lock capable of accepting a Best Lock Company 6-pin CX series core. The Contractor shall supply green construction cores with two master keys and one core removal key per lock. The Contractor shall deliver the keys to the Engineer.
- 3. The Contractor shall provide the termination block one type R66B 25-pair stubless bifurcated quick clip terminal for each TWP cable and one for every three 6 TWP cables. One more quick clip terminal shall be installed on a backboard in the cabinet.

8-20.2.OPT18(L).ITS.DT1
(NWR ITS October 16, 2006)
Fiber Optic Terminal Cabinets

Fiber optic terminal cabinets furnished for this contract shall be pad mounted and have the same external physical dimensions and appearance as Model 334 cabinets. Fiber optic terminal cabinets shall be fabricated in accordance with Section 9-29.25 except:

- 1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
1. Cabinets shall be fabricated of 0.125" sheet aluminum, 5052 alloy, with mill finish, in accordance with Section 9-29.13(7)D, Item number 1. Painted or anodized aluminum is not allowed.
2. Cabinet doors shall have a three-point latch and two-position stop assembly with spring loaded construction core lock capable of accepting a Best Lock Company 6-pin CX series core. The Contractor shall supply green construction cores. Upon substantial completion, the Contractor shall deliver two master keys and one core removal key to the Engineer.
3. The cabinet shall be equipped with an electric strip heater with a rating of 100 watts and 120 VAC and a ventilation fan meeting the requirements specified in Chapter 12 of FHWA IP-78-16.

The fan and strip heater shall be controlled by a high-low adjustable thermostat that can be set to ensure the cabinet interior temperature remains between 60°F and 125°F. The heater strip shall be shielded.
4. Two shatterproof fluorescent interior cabinet lights with self-starting ballast shall be furnished, one fixture mounted on the rear rack near the top and the second mounted at the top of the front rack. Door switches shall automatically turn on both lights when either door is opened.
5. The cabinet shall be equipped with a power distribution panel mounted on a standard EIA 19-inch (ANSI/EIA RS-310-C) rack utilizing no more than five RMU (8.75 inches). The following devices shall be provided with the power distribution panel:
 - a. Duplex 120 VAC power receptacle.
 - b. Main circuit breaker, 120 VAC, 50 amp.
 - c. Four load circuit breakers, 120 VAC, 15 amp.
 - d. Neutral bus.
 - f. Ground bus.
 - g. Surge suppresser and filter unit, 120 VAC, 50 amp.

Power distribution panel components shall be mounted in or on the panel such that they are readily accessible, provide dead front safety, and all hazardous voltage points are covered to prevent inadvertent contact.
6. One controller unit shelf, which attaches to the front of rails of the EIA rack, shall be provided. The shelf shall be fabricated from aluminum and shall contain a roll-out flip-top drawer for storage of wiring diagrams and manuals.
7. The Contractor shall provide and install a rack-mounted, preterminated, fiber optic patch panel as identified in the Plans.

8-20.2.OPT19.ITS.DT1

Video, Voice, & Data Distribution And Transmission Systems

8-20.2.OPT19(A).ITS.DT1

(NWR ITS February 11, 2002)

If any equipment specified in this section has been superseded by a newer product that is interchangeable, the newer product shall be supplied. If the product is no longer available and has no replacement, the Contractor shall propose a different product meeting the same performance and material specifications as the discontinued one.

8-20.2.OPT19(B).ITS.docx

(*****)

Video, Voice, & Data Distribution And Transmission System Cabling

The Contractor shall provide and install all required equipment interconnection cabling to include T1 cables, data cables, RG-59/U video coaxial cables, power cables, ancillary cables, and connectors as recommended by the equipment vendor at the cabinet locations and at the TMC. Conductors shall be of all copper construction.

The Contractor shall provide and install fiber optic patch cords between the fiber optic preterminated patch panels and the equipment specified herein where fiber optic cable is utilized as the transmission medium.

8-20.2.OPT19(C).ITS.DT1

(NWR ITS February 23, 2009)

Video, Voice & Data Distribution Equipment

Video, voice, and data distribution equipment shall be manufactured by Optelecom, Inc.

1. Equipment Model Numbers:

Digital Video Transmitter (stand-alone)	9225DT/SM-FC
Digital Video Receiver	9221DR/SM-FC
Drop/Insert Data Modem	9522A-LD-FC
Network Interface Card	9942A
Network Interface Software	9900-NMS
Hub Chassis	9002
Cabinet Chassis	9003-2
Power Supply (for Hub Chassis)	9030B
AC/DC Adapter (for Cabinet Chassis)	9010PS
AC/DC Adapter (for 9225DT)	9014PS

2. Manufacturer Information:

Optelecom Inc.
12920 Cloverleaf Center Dr.
Germantown, MD 20874
Telephone: (301) 444-2200

1 8-20.2.OPT19(D).ITS.DT1
2 **(NWR ITS February 23, 2009)**
3 **VMS Modem**
4 Each VMS cabinet connected to the ITS system on twisted pair wire shall be
5 equipped with a modem designed for copper communications. The modems for
6 each VMS shall be manufactured by GDI Communications LLC.
7
8 1. Equipment Model Numbers:
9
10 Stand-alone 9600 bps modem 496SA
11 Rack-mounted 9600 bps modem 496
12
13 2. Manufacturer Information:
14
15 GDI Communications LLC
16 280 Interstate 80 West Exit 1
17 PO Box 1330
18 Verdi, NV 89439 USA
19 Telephone: (775) 345-8000
20 Fax: (775) 345-8010
21 Support@sgdi.net
22
23 8-20.2.OPT19(F).ITS.docx
24 **(*****)**
25 **Ethernet Communication Equipment**
26 Ethernet communication equipment shall be manufactured by RuggedCom, Inc.
27 and installed in each cabinet and Communication Hub as shown in the Plans.
28 Equipment shall include a power cord.
29
30 1. Equipment Model Numbers
31
32 8-port Ethernet Switch RS900-HI-D-L2-L2-00
33 9-port Ethernet Switch RS900-HI-D-L2-L2-L2
34 Ethernet Switch with Device Server RS910-HI-D-S1-FX06-TX
35 Cabinet Device Server RMC30-HI
36 Power Cord 43-10-0008
37
38 2. Manufacturer
39
40 RuggedCom, Inc.
41 30 Whitmore Rd
42 Woodbridge, Ontario, Canada L4L 7Z4
43 Tel: (905) 856-5288 Fax: (905) 856-1995
44 Toll Free: (888) 264-0006
45 www.ruggedcom.com
46
47 8-20.2.OPT19(I).ITS.docx
48 **(*****)**
49 **Video Transmission System Equipment**
50 Video transmission system equipment shall be manufactured by Communication
51 Specialties, Inc.
52

1. Equipment Model Numbers:

10-channel digital video transmitter	Pure Digital Fiberlink 3134-F9-NA
10-channel digital video receiver	Pure Digital Fiberlink 3135-F9-NA

2. Manufacturer Information:

Communication Specialties, Inc.
55 Cabot Court
Hauppauge, NY 11788
Telephone: (631) 273-0404
Fax: (631) 273-1638
www.commspecial.com
info@commspecial.com

8-20.2.OPT19(J).ITS.DT1

(NWR ITS October 21, 2003)

Video and Data Transmission System Equipment

Video and data transmission system equipment shall be manufactured by Communication Specialties, Inc.

1. Equipment Model Numbers:

10-channel digital video transmitter	Pure Digital Fiberlink 3332-F-9
10-channel digital video receiver	Pure Digital Fiberlink 3333-F-9

2. Manufacturer Information:

Communication Specialties, Inc.
55 Cabot Court
Hauppauge, NY 11788
Telephone: (631) 273-0404
Fax: (631) 273-1638
www.commspecial.com
info@commspecial.com

8-20.2.OPT19(K).ITS.DT1

(NWR ITS September 26, 2005)

EIA -422 Combiner Unit

The Contractor shall provide and install the EIA-422, 4-wire combiner as shown in the Plans. The combiner shall be manufactured by Vicon, Inc. The Contractor shall provide and install cables from the combiner to the Video/data receivers. The combiner shall have one master port and 10 output ports:

1. Equipment Model Numbers:

Combiner: Model V1400X-IDL Intelligent Distribution Line Control

2. Manufacturer Information:

Vicon Industries, Inc.
89 Arkay Drive
Hauppauge, NY 11788

Telephone: (800) 645-9116
or (631) 952-2288
www.vicon-cctv.com

8-20.2.OPT19(L).ITS.DT1

(NWR ITS October 23, 2006)

EIA –232 Data Broadcast Unit

The Contractor shall provide and install a rack-mounted EIA-232 data broadcast unit. The data broadcast unit shall be manufactured by Black Box, Inc. The broadcast unit shall have one master port and 8 output ports:

1. Equipment Model Numbers:

8-Line Broadcast data broadcast unit TL158A-R4
Rack-mount bracket TL486

2. Manufacturer:

Black Box, Inc.
1000 Park Dr
Lawrence, PA 15055-1018
Telephone: (877) 877-2269
www.blackbox.com
e-mail: info@blackbox.com

8-20.2.OPT19(M).ITS.DT1

(NWR ITS February 23, 2009)

Rack-mounted Color Monitor

The monitor shall be a color video monitor with a 13" or 14" diagonal picture LCD. The monitor shall support EIA NTSC standard color composite video signals (1.0 V p-p, 75 Ohm) and have a resolution of at least 400 horizontal lines. The monitor shall include a minimum of two video input ports; one shall be BNC-type for composite video and one shall be 4-pin (Y/C) type for S-Video. The video output port shall be BNC-type for composite video. The monitor shall include a rear panel slide switch that enables video termination of Hi-Z or 75 ohm.

The monitor's power source shall be 120 VAC +/- 10%, 60Hz.

The monitor dimensions shall not exceed 14"(H) by 18"(D). The monitor shall have a metal casing and be factory-equipped with rack-mounting hardware (EIA 19"). The monitor weight shall not exceed 40 lb.

The Contractor shall supply one BNC coaxial patch cord (RG-59U) of sufficient length to connect the monitor to all video sources mounted in the rack.

The monitor shall be manufactured by Sony, JVC, or Philips

(NWR ITS February 23, 2009)

SONET Network Element

The Contractor shall install and connect SONET network elements as shown in the Plans to provide voice and data communications over fiber optic cable. The network elements shall provide OC-48 service. The network element shall be capable of providing local interface for Gigabit Ethernet, 10/100 Ethernet and T-1 services. The SONET network elements shall be manufactured by Cisco Systems, Inc.

1. Equipment Model Numbers:

Description	Part Number	Qty
15454 ATO (Assemble to Order)	CISCO15454	1
15454 Network Element shelf with ship kit	15454-SA-HD	1
15454 Shelf Fan Tray Assembly, HPCFM, I-Temp	15454-FTA3-T	1
Alarm Interface Controller Card, I-Temp	15454-AIC-I	1
Electrical Interface Panel (A-side)	15454-EIA-1AMPA84	1
Timing, Communications, and Control v2-plus Card, I-Temp, SONET	15454-TCC2P-K9=	2
System Software, Pre-loaded on TCC (Current Release)	SF15454-R(Cur.Rel.)K9	2
Cross-connect Card, 1152 STS, 672 VT	15454-XC-VXC-10G	2
Cable Assembly, AMP/champ to wire-wrap (15 ft).	15454-AMP-WW-15=	1
DS1 Card, I-Temp	15454-DS1-14	1
DS1:N Protection Card, I-Temp	15454-DS1N-14	1
12-port 10/100BaseT Ethernet Card	15454-ML100T-12	1
Gigabit Ethernet Card with 2 GBIC Slots	15454-ML1000-2	1
GBIC - 1000Base-SX, MM, SC connectors	ONS-SC-GE-SX=	2
Long Range OC-48 Card, 1550, 1 Ckt., SC connectors	15454-MRC-2.5G4	2
SFP - OC48, LR, 1550, I-Temp	ONS-SI-2G-L2	4
Empty slot Filler Panel	15454-BLANK	6
Feature Pkg. CD, Right to Use License, 15454 (Current Release)	15454-R(Cur.Rel.)SWK9	1
System Documentation, English, CD (Current Release)	15454-DOC(Cur.Rel.)CD	1

2. Manufacturer Information:

Cisco Systems, Inc.
 170 West Tasman Drive
 San Jose, CA 95134
 Telephone: (408) 526-4000
www.cisco.com

Local Contact:

1 Mr. Fred Fox
2 Optical Products Specialist
3 500 108th N.E. Suite 500
4 Bellevue, WA 98004
5

6 8-20.2.OPT19(O).ITS.DT1
7 **(NWR ITS September 26, 2005)**
8 **Fuse Panel**
9 The Contractor shall provide, install and connect a fuse panel as shown in the
10 Plans. The fuse panel shall be manufactured by Comm/net Systems, Inc.
11

12 1. Equipment Model Numbers:
13
14 KTK Fuse/Alarm Panel 016-105-10
15 KTK Fuse, 10 Amp KTK-10
16 KTK Fuse, 30 Amp. KTK-30
17

18 2. Manufacturer Information:
19
20 Communications Network (Comm/net) Systems, Inc.
21 4237 24th Ave. W.
22 Seattle, WA 98199
23 Telephone: (206) 282-8670
24

25 8-20.2.OPT19(P).ITS.DT1
26 **(NWR ITS September 26, 2005)**
27 **Cross-Connect Panel**
28 The Contractor shall provide and install digital cross-connect panels as shown in
29 the Plans. The Cross-connect panels shall be used to connect and terminate DSX
30 circuits from the SONET equipment. The cross-connect panels shall be
31 manufactured by ADC Telecommunications, Inc.
32

33 1. Equipment Model Numbers:
34
35 DSX1 Shelf, 19" PX1-B00004
36 DSX1 Octapak housing PIX-1C-OCT
37 DSX1 Circuit Card PIX-1C
38

39 2. Manufacturer Information:
40
41 ADC Telecommunications, Inc.
42 4900 West 78th Street
43 Minneapolis, MN 55435
44 Telephone: (800) 366-3891
45 www.adc.com
46

47 8-20.2.OPT19(Q).ITS.docx
48 **(*****)**
49 **Video Encoder/Decoder**
50 The Contractor shall provide and install video encoding equipment at locations
51 shown in the Plans and video decoding equipment in Dayton Avenue Traffic
52 Management Center (TMC).

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52

1. Equipment Model Numbers:

1-port video encoder (standalone)	Axis Q7401
1-port video decoder (standalone)	Axis P7701
4-port video encoder (standalone)	Axis Q7404
6-port video encoder (blade)	Axis Q7406
Server chassis (1 RMU)	Axis 291

2. Manufacturer Information:

Axis Communications Inc.
100 Apollo Drive
Chelmsford, MA 01824
Telephone: 978 614 2000
www.axis.com

8-20.2.OPT46.ITS.DT1

(NWR ITS February 23, 2009)

Communication Hub / Concrete Universal Enclosure (CUE)

The concrete universal enclosure shall be supplied by Emerson Network Power.

1. Equipment Model Numbers:

Concrete Universal Enclosure CUE-610 (F2007097)

2. Manufacturer Information:

Emerson Network Power
ATTN: Mr. Scott Hein
4350 Weaver Parkway
Warrenville, IL 60555
Telephone: (630) 579-5256
<http://www.emersonnetworkpower.com/energysystems/>

General

The enclosure shall function as an unattended facility with a controlled-environment suitable for the installation of the system equipment and regular, safe inspection and maintenance by operating personnel. Appropriate electrical, mechanical, and environmental systems shall be provided to support the specific equipment installation.

Enclosure Description

The enclosure shall be a manufactured concrete enclosure, intended for partial underground installation. The structure shall be manufactured of 5000PSI steel-reinforced pre-cast concrete with a heavy gauge metal door and cable rearrangement facility (CRF).

Personnel access shall be through an entrance door that shall be the only access to the enclosure interior. A vertical ladder shall be provided within the entranceway. The entry size shall be nominally 56.5 inches high x 28 inches wide and provide a clear entry area for system equipment components that are field installed. The entrance shall include a heavy-duty locking mechanism controlled by a keyed cylinder lock set for security.

The lock mechanism shall be a Best Lock Company 7-pin CX series, manually operable from within (to avoid entrapment) and key operable from the exterior. The exterior lock cylinder shall be installed in a manner to provide for protection from the weather. The Contractor shall supply green construction cores. Upon substantial completion, the Contractor shall deliver two master keys and one core removal key to the Engineer. The entry door shall be equipped with a wind latch to avoid accidental closure.

Any water leakage into the enclosure could disrupt the system equipment operation. Therefore, the enclosure design shall minimize any leakage potential, and as an added measure, provide for containment of water in a below-floor sump area. Water containment capacity and monitoring shall be sufficient to provide adequate warning (under normal circumstances) to permit the dispatch of personnel to investigate any problem.

Cable entry and/or exit are to be provided as four (4), 4-inch diameter openings into the cable rearrangement facility (CRF) cabinet at the rear of the enclosure. No outside plant cable shall be brought into the enclosure. No metallic conduit connections to field conduits shall be permitted. Power shall be supplied to the enclosure via a 2.5-inch port in the power transfer switch cabinet located on the exterior of the enclosure.

An overhead cable ladder rack and a fiber management system shall be supplied with the enclosure.

The enclosure shall include a fold-up work table attached to the wall as shown in the plans. Nominal dimensions of the table shall be 3 feet wide by 2 feet deep.

The enclosure shall be complete with the necessary electrical and environmental equipment preinstalled to provide a safe, controlled environment suitable for personnel and the electronic system.

Enclosure Environmental System

An Environmental Control Panel (ECP) shall be provided to monitor all environmental conditions within the enclosure and shall control respective equipment to maintain or correct the condition(s) that exist. This panel shall also provide contacts for remote alarm indications.

The enclosure shall be equipped with dual 12000 BTU air conditioners to maintain proper temperature levels.

The enclosure environmental system shall be capable of maintaining a controlled environment including the maintenance of interior temperatures within a nominal range of between 40° F and 90° F.

1 An atmospheric monitor shall be provided with the ECP to continuously sample the
2 air with the enclosure. The monitor functions and remote alarms are described in a
3 following section of this specification.
4

5 An immediate visual indication of a safe or hazardous enclosure atmosphere shall
6 be provided by green and red pilot lights visible through the open entrance door.
7 Audible alarms shall supplement the visual indication during potentially hazardous
8 conditions. Safe conditions shall be indicated with a continuous green light.
9 Unsafe conditions shall be indicated with a continuous red light and audible alarm
10 horn. In addition, an unsafe atmospheric condition shall activate the ventilation
11 system to purge the enclosure chamber and initiate a remote alarm.
12

13 A sump pump shall be provided as part of the CUE. The pump shall be mounted in
14 a sump pit to which water is channeled via a trough around the floor perimeter. The
15 pump shall activate alarms upon activation of the float switch.
16

17 **Enclosure Security/Monitor Alarms**

18 Alarm indications shall be wired to an Alarm Terminal Block (ATB) so the existence
19 of any alarm condition can be transmitted to a remote location. The alarm
20 indications shall be given as a dry, normally open contact closure. No indication of
21 remote (silent), dry contact alarms need be provided at the enclosure; however,
22 hazardous alarm conditions shall provide audible or visual alarm indications at the
23 enclosure when occupied for personnel safety. No audible alarm should be heard
24 when the enclosure is unoccupied; however, the remote alarm shall continue to
25 function. Upon opening the entry door, any pre-existing hazardous condition shall
26 immediately trigger the local alarms.
27

28 The Contractor shall provide all necessary equipment and wiring to connect the
29 above alarms to the Administrative, Operations, Maintenance facilities of the
30 SONET system so as to provide a functioning alarm system from the
31 Communication Hub to the TSMC at Dayton.
32

33 The following alarms shall be provided for:
34

35 **Intrusion Alarm**

36 A remote alarm indication shall be activated immediately upon opening the
37 entrance door. Closing the entrance door shall restore the alarm switch to its
38 normal position.
39

40 **Water Detection Alarm**

41 A water sensor located approximately 8 inches below floor level shall signal a
42 remote alarm condition if water is present at the sensor. The sensor shall
43 detect water film depth as little as 1/16 inch. This shall provide an early alarm
44 for a cable duct leak or other water leakage that could damage the system
45 equipment and the enclosure interior if the condition is not corrected.
46

47 **Sump Pump Run Alarm**

48 The ECP shall monitor the sump pump operation and provide a remote alarm
49 indication if the pump is running.

High Water Alarm

A float switch shall monitor water level and initiate a final water alarm in the event of a rise in water level beyond the capability of the sump pump. This alarm point shall occur at least 4 inches below the floor level where equipment is installed.

Explosive Atmosphere Alarm

An alarm indication shall be activated by an unsafe condition reported by the Atmospheric Monitor explosive-gas sensing element. Explosive gas is defined as 10% or more lower explosive level (LEL) of Methane. Detection of explosive gas shall:

- (1) initiate a remote alarm,
- (2) give an immediate, steady red pilot light indication in the entrance way,
- (3) activate the fresh air blower,
- (4) sound a local alarm.

The remote alarm shall provide an immediate remote alarm indication, even though the fresh air blower may clear the explosive condition. Additionally, the local audible alarm and red pilot light shall be activated for immediate indication of a hazardous condition. It shall not be possible to silence the local audible alarm at the enclosure, and the red pilot light shall remain lighted until the condition clears. Once the Atmospheric Monitor reports a safe condition, these alarms and indications shall be automatically deactivated.

Toxic Atmosphere Alarm

An alarm indication shall be activated by an unsafe condition reported by the Atmospheric Monitor toxic gas sensing element. Toxic gas (100 parts/million Carbon Monoxide) detection shall:

- (1) initiate a remote alarm,
- (2) give an immediate, steady red pilot light indication in the entrance way,
- (3) activate the fresh air blower,
- (4) sound a local alarm.

The delayed remote alarm shall provide an opportunity for the fresh air blower to clear the toxic condition before reporting the condition remotely. Locally, however, the audible alarm and red pilot light shall be activated for immediate indication of a hazardous condition. It shall not be possible to silence the local audible alarm at the enclosure and the red pilot light shall remain lighted until the condition clears. Once the Atmospheric Monitor reports a safe condition, these alarms and indications shall be automatically deactivated.

Smoke Alarm

The atmospheric monitor shall incorporate a photoelectric smoke detector. Upon detection the system shall:

- (1) initiate a remote alarm,

- (2) give an immediate, steady red pilot light indication in the entrance way,
(3) deactivate and lock out the fresh air blower,
(4) sound a local alarm.

The audible alarm and red pilot light shall be activated for immediate indication of a hazardous condition. It shall not be possible to silence the local audible alarm at the enclosure and the red pilot light shall remain lighted until the condition clears. Once the Atmospheric Monitor reports a safe condition, these alarms and indications shall be automatically deactivated.

Atmospheric Monitor Failure Alarm

The atmospheric monitor shall initiate a remote alarm condition upon:

- (1) failure of any gas sensor,
(2) failure of AC and DC backup power sources.

High Humidity Alarm

An alarm humidistat shall be provided at the ECP to give a remote alarm indication if the relative humidity (RH) reaches a preset level. The High Humidity alarm point shall be adjustable between 20% and 80% RH.

High Temperature Alarm

An alarm thermostat shall be provided at the ECP to give a remote alarm indication if the enclosure interior temperature exceeds a preset level. The High Temperature alarm point shall be selectable in a range from 55 to 175 degrees Fahrenheit. The alarm shall activate when the temperature in the CUE reaches 110° F, and reset at 90° F.

Power Failure Alarm

An interruption of the Utility Service shall cause a remote alarm indication. Restoration of power shall silence the alarm. Both legs of the 120/240V single-phase service shall be monitored so a failure of either one or both legs shall trigger the alarm condition.

Power Transfer Switch

The enclosure shall be equipped with an automatic Power Transfer Switch (PTS) to allow connection of an external generator in the event of an extended power outage. The PTS shall be located on the outside of the enclosure next to the entrance door and shall be equipped with a connecting plug suitable for use with existing State owned ONAN generators, and shall be able to communicate with the State owned generators

PTS Equipment Model Numbers:

Transfer Switch-Power Command: 40A/70A/125A

OTPC125	Automatic Transfer Switch-Onan, PwrCmd, 125 Amp
A028-7	Poles – 3
A035-7	Application - Utility To Genset
A046-7	Listing – UL 1008/CSA Certification
A044-7	Frequency – 60 Hertz

1	A041-7	System – Single Phase, 2 wire or 3 wire
2	R023-7	Voltage – 240 VAC
3	B002-7	Cabinet – Type 3 (outdoor)
4	C023-7	Control – Transfer Switch, Level 1
5	N020-7	Terminal Block – Retransfer Inhibit
6	G002-7	Transfer Switch Warranty – 1 year basic
7	CP01-7	Common parts listing
8	SPEC-A	Product revision – A
9	C024-7	Switch control – Level 2
10	M017	Security key – Front panel
11	M018	Display – Digital

Generator Plug: Appleton Model ADR1034RS with AJA-100 Adaptor

Uninterruptible Power Supply (UPS)

A 3KVA rack-mounted UPS with extended battery packs shall be installed in the 23" UPS rack. The battery packs shall be installed midway in this rack followed by the UPS and External maintenance bypass switch.

The UPS shall be an Alpha Technologies Pinnacle 016-313-10 equipped with three (3) extended battery pack part numbers 016-315-10. The UPS system shall be connected to a dedicated power circuit hardwired from the hub circuit breaker panel. The output of the UPS system shall be hardwired to a wall-mount circuit breaker panel to provide UPS power to outlets mounted on the walls behind the equipment racks and next to the fold down table. Alarm contact outputs from the UPS alarm output terminations shall be wired using Category 3 cable to the appropriate terminal block location in the hub to be specified by the engineer.

A maintenance bypass switch (MBS) shall be provided and installed in the UPS rack directly above the UPS. The MBS shall allow a dedicated circuit from the hub circuit breaker panel to feed the utility bypass input of the MBS and from the MBS output to the UPS wall mount circuit breaker panel that feeds the outlets behind the equipment racks.

Equipment Model Numbers:

UPS: Alpha Technologies Pinnacle PIN 3000RM
Extended Battery Pack: PBP36-0706U2R

DC Power System

A rack-mounted –48 volt DC power system shall be provided as part of the CUE. The DC power system shall operate separately from the UPS system and shall be used to power all –48VDC equipment.

The DC power system shall consist of a modular dual rectifier, low voltage disconnect module, control panel and battery pack capable of powering the Voice and Data Transmission equipment. The output of the rectifiers shall be adjustable by front panel control. A front panel mounted display shall be provided as part of the power supply.

A battery supply and mounting tray shall be provided. Batteries shall be mounted in the lower part of the rack with the rectifier system installed above.

Equipment Model Numbers:

Rectifier System: Emerson VMS-75

With 2 ea VF15F50 Power conversion unit, 1 ea DC Distribution module
and 1 ea Meter-Control module

Battery Pack: 12AVR100-3ET (Includes Tray and Harness)

8-20.2(9-29.1).DT1

Conduit, Innerduct, and Outerduct

8-20.2(9-29.1).INST1.ESP.DT1

Section 9-29.1 is supplemented with the following:

8-20.2(9-29.1).OPT1.ESP.DT1

(NWR August 10, 2009)

Conduit Sealing

Mechanical plugs for cabinet conduit sealing shall be one of the following:

1. Tyco Electronics - TDUX
2. Jackmoon – Triplex Duct Plugs
3. O-Z Gedney – Conduit Sealing Bushings

The mechanical plug shall withstand a minimum of 5 psi of pressure.

8-20.2(9-29.1(2)).OPT2.ESP.DT1

(NWR March 4, 2009)

Surface Mounting Conduit Attachment Components

Channel supports and all fastening hardware components shall be Type 304 stainless steel. Conduit clamps shall be one piece, two bolt units with lock washers.

8-20.2(9-29.2).DT1

Junction Boxes, Cable Vaults and Pull Boxes

8-20.2(9-29.2(4)).DT1

Cover Markings

8-20.2(9-29.2(4)).INST1.ESP.DT1

Section 9-29.2(4) is supplemented with the following:

8-20.2(9-29.2(4)).OPT1.ESP.DT1

(NWR October 5, 2009)

Junction Box Identification

Junction boxes shall not be marked when the junction boxes are to be installed as part of a future raceway system in a bridge structure, vehicle barrier, pedestrian barrier, or roadway crossing and the future raceway system is not connected to an illumination, signal, interconnect, or ITS raceway system.

8-20.2(9-29.3).ITS.DT1

Conductors, Cable

Section 9-29.3 is supplemented with the following:

8-20.2(9-29.3).OPT1.ITS.DT1

(NWR ITS April 10, 2006)

Communication Cables And Interfaces

Quality Assurance

All materials described in this section shall meet or exceed the applicable provisions of the following documents:

1. CFR Title 7, Section 1755.900, RUS Specification for Filled Fiber Optic Cables
2. ANSI, C8.47-1983, American National Standard for Polyolefin-insulated Thermoplastic Jacketed Communication Cables
3. TIA/EIA-455-28-C, Method for Measuring Tensile Failure Point of Optical Waveguide Fibers
4. TIA/EIA-455-34-A, Interconnection Device Insertion Loss Test
5. TIA/EIA-455-95-A, Absolute Optical Power Test for Optical Fibers and Cables
6. EIA-598-B, Color Standard for Optical Fibers

8-20.2(9-29.3(1).ITS.DT1

Fiber Optic Cable

Section 9-29.3(1) is supplemented with the following:

8-20.2(9-29.3(1).OPT1.ITS.docx

(***)**

Communication Cables And Interfaces

The Contractor shall provide manufacturer's certification that the submitted cable shall comply with the Rural Utilities Service (RUS) Specification 1755.900 as currently amended and with the requirements set forth in this Special Provision. Any deviations from these specifications shall be conspicuously noted in the Contractor's submittal.

Each cable shall contain the total number of optical fibers as specified in the Plans. For all cables, the fibers shall be placed in loose buffer tubes in groups of 12.

The fiber optic cable outer jacket shall be marked with the manufacturer's name, the year of manufacture, the words OPTICAL CABLE and sequential meter marks. The markings shall be repeated every one meter. The actual length of the cable shall be within +/- 0.1% of the length marking. The marking shall be in contrasting color to the jacket. The marking shall be 2.5mm in height and shall be permanent and weatherproof.

Cable shall be of loose tube design. The tubes shall be surrounded by dry moisture blocking filling compound or tape. The tubes may be filled with dry moisture blocking powder surrounding the fibers.

The cable shall be constructed with the following components:

1. A dielectric central strength member
2. Buffer tubes containing optical fibers
3. Aramid (Kevlar) yarn
4. Outer MDPE jacket

The Contractor shall provide all materials required for the installation and splicing of the specified communications cables, power cables and associated interface devices.

The Contractor shall provide an unconditional warranty on all installed cable for a period of one (1) year.

At the request of the Engineer, the Contractor shall submit a 3-foot sample cable section to the Engineer for approval for each type of cable to be provided.

8-20.2(9-29.3(1)A).ITS.DT1

Singlemode Optical Fibers

Section 9-29.3(1)A is supplemented with the following:

8-20.2(9-29.3(1)A).OPT1.ITS.DT1

(NWR ITS October 31, 2005)

Communication Cables And Interfaces

Optical fiber shall meet the requirements of ITU G652 and specifically meet ITU G652.D Attributes. The fibers shall support the transmission of wavelengths for Coarse Wavelength Division Multiplexing (CWDM) as defined in ITU G694.2.

8-20.2(9-29.3(1)A).OPT2.ITS.DT1

(February ITS 11, 2002)

Communication Cables And Interfaces

Multimode Optical Fibers

All multimode optical fiber cable shall be of a loose tube buffer design and of industry standard construction for underground conduit installations as well as of an all dielectric construction.

Each optical fiber shall be fabricated from 100 K PSI glass and shall meet this specification.

The multimode fibers shall have a nominal core diameter of 62.5 microns, with no variation greater than 3 microns. The non circularity of the core surface shall be less than 6 percent. Core non circularity is defined as the difference between the longest and shortest chords each passing through the center of the core and connecting on the core/cladding interface, divided by the average core diameter.

Optical fiber dimensions shall be in compliance with the methods for measuring as established in EIA-STD, 455-176.

The multimode cladding shall have a nominal outside diameter of 125 microns with no variation greater than 3 microns. Non circularity of the cladding surface shall be less than 4 percent. Cladding non circularity is defined as the difference between the longest and shortest chords, each passing through the center of the cladding and connecting points on the outer cladding surface, divided by the average diameter of the cladding surface.

The concentricity error for multimode optical fibers shall be less than 6 percent, where the error is the distance between the core and cladding centers divided by the average core diameter.

The coated multimode optical fibers shall have a nominal outside diameter of 250 microns, with no variation greater than 15 microns and a minimum coating thickness of 50 microns.

Fibers shall contain no factory splices.

The maximum attenuation of each 62.5/125 multimode fiber at the temperature range of -40°C. to +70°C. shall be no greater than 1.00 dB/km at 1310 nm nominal. The information transmission capacity (bandwidth) for each multimode optical fiber shall be 500 MHz-km. The attenuation shall be measured on a completed reel length of cable then normalized to a length of 1 km. The measurement method shall be in accordance with the manufacturer's recommended procedure.

All fibers shall be free from imperfections and inclusions that would prevent them from meeting the transmission and mechanical requirements of this specification. Anomalies shall not exceed 0.20 dB.

The maximum dispersion at 68°F. shall be 2.6 ps/nm-km over the range of 1225 to 1330 nm.

The cutoff wavelength shall be 1200 nm nominal, and shall have no variation greater than 70 microns.

Optical Performance

The optical performance shall meet the requirements of the specifications.

Contractor shall warrant that the installed cable shall provide an absolute maximum attenuation of no greater than 3.0 dB/km at 850 nm nominal and 1.0 dB at 1300 nm nominal for each 62.5/125 multimode fiber at the temperature range of -40°C. to +70°C. The attenuation of multimode fibers shall be determined by EIA-STD-455-46.

The information transmission capacity (bandwidth) of each multimode optical fiber shall be 500 MHz_km. The information capacity of each fiber shall be measured in the time domain environment and the result shall be expressed in terms of _3 dB (optical power) frequency. The method to determine the pulse distortion shall be EIA,-STD-455-51.

8-20.2(9-29.3(2)).ITS.DT1

Twisted Pair (TWP) Copper Cable

Section 9-29.3(2) is supplemented with the following:

8-20.2(9-29.3(2)).OPT1.ITS.DT1

(NWR ITS September 26, 2005)

Communication Cables And Interfaces

The twisted pair cable outer jacket shall be marked with the manufacturer's name, the year of manufacture, and sequential meter marks. The markings shall be repeated every one meter. The actual length of the cable shall be within +/- 0.1% of the length marking. The marking shall be in contrasting color to the jacket. The marking shall be 2.5mm in height and shall be permanent and weatherproof.

8-20.2(9-29.3(2)).OPT2.ITS.DT1

(***)**

Outdoor Rated Category 6 Cable

A Category 6 outside plant rated cable shall be provided for connecting Ethernet devices that are in separate cabinets. The cable shall contain four twisted pairs of #23 or 24AWG solid bare copper wire. Each pair shall be uniquely color coded with a Thermoplastic polyolefin jacket.

The cable outer jacket shall be Polyolefin with a minimum wall thickness of 0.040". The cable shall consist of water blocking material in the cable interstices for moisture protection.

The cable shall have a voltage rating of 300V.

The cable shall be UL listed. It shall support up to IEEE 802.3 1000Base-T Ethernet and IEEE 802.3af for power over Ethernet.

The cable shall be terminated on each end with an RJ45 connector.

8-20.2(9-29.12(2)).ESP.DT1

Traffic Signal Splice Material

8-20.2(9-29.12(2)).INST1.ESP.DT1

Section 9-29.12(2) is supplemented with the following:

8-20.2(9-29.12(2)).OPT1.ESP.DT1

(NWR March 1, 2011)

Induction loop splices shall be either the heat shrink type or the re-enterable type with end cap seals.

1 8-20.2(9-29.13).ITS.DT1

2 **Traffic Signal Controllers**

3 Section 9-29.13 is supplemented with the following:

4
5 8-20.2(9-29.13).OPT1.ITS.DT1

6 **Traffic Data Accumulation And Ramp Metering System**

7
8 8-20.2(9-29.13).OPT1(A).ITS.DT1

9 **(NWR ITS February 23, 2009)**

10 **Model 170E Controller**

11 Each ramp meter and data station controller unit furnished shall meet the
12 requirements specified in Chapter 2 of the Caltrans Transportation Electrical
13 Equipment Specification (TEES), August 2002, as currently amended and
14 modified as follows:

- 15
16 1. The 170E CPU module shall operate a 68HC11F1 MPU at a crystal
17 frequency of 8MHz. The MPU shall be socket mounted in a PLCC
18 socket.
- 19
20 2. The EPROM shall be resident on the CPU module. The EPROM
21 socket shall be a 32-pin lever-controlled ZIF device. The EPROM
22 shall be either a 32K x 8 or a 128K x 8 device. The device size shall
23 be jumper selectable.
- 24
25 3. Feature and Location switches shall be provided on the front portion
26 of the CPU module. Each switch shall be an 8-position front-reading
27 DIP switch. The switches shall be addressed as follows:
28
29 Location Switch at 7000 (Port A)
30 Feature Switch at 700A (Port E)
- 31
32 4. There shall be one LED indicator located on the front of the CPU
33 module. This LED shall be connected to bit 3 of Port G.
- 34
35 5. The 170E controller shall have a minimum of 28 kB of battery backed
36 static RAM on the CPU module. RAM shall be continuous from
37 location 0000 to 6FFF.
- 38
39 6. Four Asynchronous Communication Interface Adapters (ACIAs) shall
40 be provided on the same board as the CPU. The ACIAs shall be
41 6850 ICs operating at a crystal frequency of 6.144MHz. Each ACIA
42 shall have 5 programmable jumpers to select 5 communication baud
43 rates (1200, 2400, 4800, 9600, 19200) for a total of 20 jumpers. All
44 ACIAs shall be active. An IRQ status register shall be provided
45 at 75FF.
- 46
47 7. The Model 412C PROM module shall not be provided. A blank
48 panel shall cover the PROM slot.
- 49
50 8. Two blank 27256 EPROM chips shall be provided with the CPU
51 module.
- 52

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51

9. Each controller shall have an ACIA C20 wrap-around with the following pin connections:

C20 Function Pin		C20 Function Pin	
(J) RTS	to	(M)	CTS
(J) RTS	to	(H)	DCD
(K) DATA-IN	to	(L) DATA-OUT	

- 8-20.2(9-29.13).OPT1(A)1.ITS.DT1
(NWR ITS February 11, 2002)
10. Each 170E controller shall include a Model 400 modem.
- 8-20.2(9-29.13).OPT1(A)2.ITS.DT1
(NWR ITS February 11, 2002)
10. Each 170E controller shall include a drop/insert data modem.
- 8-20.2(9-29.13).OPT1(A)3.ITS.DT1
(NWR ITS February 23, 2009)
10. Each 170E controller shall include an unmanaged ethernet switch and a cabinet device server.
- 8-20.2(9-29.13).OPT1(B).ITS.DT1
(NWR ITS September 26, 2005)
Model 330 Cabinet
Traffic data station controller cabinet(s), *** \$\$1\$\$, shall meet the requirements specified in Chapter 12 of the Type 170E Traffic Signal Control Hardware Specification, FHWA IP-78-16, as currently amended except as modified by the following:
1. Cabinets shall be fabricated of 0.125 inch sheet aluminum, 5052 alloy, with mill finish, in accordance with Section 9-29.13(7)D, Item number 1. Painted or anodized aluminum is not allowed.
 2. Cabinet doors shall have a three-point latch and two-position stop assembly with spring loaded construction core lock capable of accepting a Best Lock Company 6-pin CX series core. The Contractor shall supply green construction cores. Upon substantial completion, the Contractor shall deliver two master keys and one core removal key to the Engineer.
 3. Visual alarm light shall not be provided
 4. Field wire terminals shall be labeled in accordance with the ITS Field Wiring Chart.
 5. One shatterproof fluorescent interior cabinet lights with self-starting ballast shall be furnished on the top of the front rack. Door switch shall automatically turn on the light when the door is opened.
 6. Pole and wall mounted cabinets shall be fully enclosed.

One controller unit shelf, which attaches to the front rails of the EIA rack, shall be provided in lieu of the two controller unit support angles. The shelf shall be fabricated from aluminum and shall be installed such that it does not interfere with access to any terminal block. The shelf shall contain a rollout flip-top drawer for storage of wiring diagrams and manuals.

Cabinet Accessories

Cabinet accessories for the Model 330 Cabinet shall be the same as the Model 334 Cabinet with the following exceptions:

- 1 The cabinet shall not contain a PDA 3.
- 2 There shall be no load switches.
- 3 A 24V swing out power supply shall be provided.
4. The display panel shall have 24 LED indicators for loops. It shall not have an Advance Warning Sign Control Switch, nor any Controller Output Indicators.
5. One 5.25-inch input file shall be supplied.
6. One rack mount vehicle loop detector shall be included for every two loops.
7. The cabinet shall not contain a police panel nor a Model 204 Flasher Unit.

8-20.2(9-29.13).OPT1(C).ITS.docx

(*****)

Model 334 Cabinet

Traffic data station and ramp meter controller cabinets furnished on this contract shall meet the requirements of Type 170E, 170E-HC-11, 2070, 2070 Lite, ATC Controller Cabinets with the following exceptions:

1. The cabinet shall be equipped with an electric strip heater with a rating of 100 watts and 120 VAC and a ventilation fan meeting the requirements specified in Chapter 12 of FHWA IP-78-16.
2. The fan and strip heater shall be controlled by a high-low adjustable thermostat that can be set to ensure the cabinet interior temperature remains between 60°F and 125°F. The heater strip shall be shielded.

8-20.2(9-29.13).OPT1(D).ITS.DT1

(NWR ITS October 4, 2004)

Rack Mount Vehicle Loop Detectors

The Contractor shall provide, install and connect inductive loop detectors manufactured by Reno A&E.

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44

1. Equipment Model Numbers:

332/170 type with solid-state outputs C-1101-SS
and TrueCount outputs
2. Manufacturer Information:

Reno A&E
4655 Aircenter Circle
Reno, NV 89502
Telephone: (775) 826-2020
www.renoae.com

8-20.2(9-29.13).OPT1(E).ITS.DT1

(NWR ITS February 23, 2009)

Rack Mount Vehicle Loop Detectors in Existing Cabinets

The Contractor shall provide, install and connect inductive loop detectors manufactured by Reno A&E in all existing cabinets that have new loops installed or existing loops replaced. One rack mount vehicle loop detector shall be included for EACH new loop installed or replaced.

1. Equipment Model Numbers:

332/170 type with solid-state outputs C-1101-SS
and TrueCount outputs
2. Manufacturer Information:

Reno A&E
4655 Aircenter Circle
Reno, NV 89502
Telephone: (775) 826-2020
www.renoae.com

8-20.2(9-29.13).OPT1(F).ITS.docx

(***)**

Non-Intrusive Vehicle Detector

The Contractor shall provide, install, and connect non-intrusive vehicle detector units in locations as shown in the Plans. The Non-Intrusive Vehicle Detector shall be manufactured by Wavetronix LLC as a completed unit including detector sensor, cable, mounting brackets, and other associated equipment.

1. Equipment Model Numbers:

1	Wavetronix 24 GHz HD125 with rotating backplate	WX-SS-125-010
1	Standard Sensor Cable with Connector (to be selected per Plan)	WX-SS-701-040 WX-SS-701-060 WX-SS-701-080 WX-SS-701-100
1	Sensor Mount - 6" 3 Axis Aluminum Bracket	WX-SS-611

1	16 Channel Contact Closure	WX-CLK-100
1	Power/RS232/RS485 Lightning Surge Protector	WX-CLK-200
1	1 Amp@ 24 VDC Power Supply	WX-CLK-201
1	Resettable Breaker/Switch .5 Amp	WX-CLK-210
1	120 Volt AC Surge Protector	WX-CLK-230
1	Din Rail 19" Bent	WX-100-0066
1	8 foot Male Plug Power Cord	WX-100-0118

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40

2. Manufacturer Information:

Wavetronix LLC
380 S. Technology Ct.
Linden, UT 84042
(801) 764-0277 (ext. 1011)
www.wavetronix.com

8-20.2(9-29.13).OPT1(G).ITS.DT1

(NWR ITS November 10, 2003)

Traffic Signal Standards

Ramp meter signal standards shall meet the requirements of Standard Plan J-7a.

8-20.2(9-29.13(7)E).ITS.DT1

Type 170E, 170E-HC-11, 2070, 2070 Lite, ATC Controller Cabinets

Section 9-29.13(7)E is supplemented with the following:

8-20.2(9-29.13(7)E).OPT1.ITS.docx

(***)**

Traffic Data Accumulation And Ramp Metering System

Each Model 334 cabinet shall be equipped with a fully operable Type 170E controller equipped as specified in these Special Provisions.

One rack mount vehicle loop detector shall be included for every two loops. Five additional vehicle loop detectors shall be installed in each new cabinet for future use.

One reproducible drafting film and two non-fading copies of the cabinet-wiring diagram shall be furnished with each cabinet.

The sign relay coil shall draw (or sink) less than 75 milliamperes from the 170E controller and have a DPDT contact rating not less than 10 amperes.

A transient voltage protection device with four outlets shall be provided, which plugs into the controller unit receptacle and in turn accepts the controller plug and communications equipment and meets the electrical requirements of Section 9-29.13(7)B(3)e.

1 **Cabinet Wiring**

2 Cabinet wiring shall conform to the details and diagrams in the Plans. The
3 Contractor shall trim wiring to eliminate all slack and lace or bind together with
4 nylon wraps or equal. All terminals shall be labeled. The cabinet shall be
5 wired completely so that the only requirement to make a field location
6 completely operational is to connect field, power and ground wires to
7 appropriate terminals.
8

9 8-20.2(9-29.18).ESP.DT1

10 **Vehicle Detector**

11
12 8-20.2(9-29.18).INST1.ESP.DT1

13 Section 9-29.18 is supplemented with the following:
14

15 8-20.2(9-29.18).OPT2.ESP.DT1

16 **(NWR March 4, 2009)**

17 **Loop Sealant**

18 Loop sealant for use in HMA pavement shall be one of the following:
19

- 20 1. RAI Pro-Seal 6006EX
21 2. QCM EAS-14
22 3. 3M Black 5000
23 4. Craftco Inc. Part #34271
24

25 When 3M Black 5000 is installed below the final lift of an HMA installation, a
26 minimum of 5 consecutive days of cure time is required before either the final lift is
27 installed or vehicle traffic is allowed over the installation
28

29 Loop sealant for use on concrete bridge decks and PCC pavement shall be one of
30 the following:
31

- 32 1. 3M Black 5000
33 2. Gold Label Flex 1P
34 3. QCM EAS-14
35

36 Loop sealant installation shall conform to the manufacturer's recommendations.
37

38 8-20.2(9-29.25).ESP.DT1

39 **Amplifier, Transformer, and Terminal Cabinets**

40
41 8-20.2(9-29.25).INST1.ESP.DT1

42 Section 9-29.25 is supplemented with the following:
43

44 8-20.2(9-29.25).OPT1.ESP.DT1

45 (NWR March 4, 2009)

46 **Cabinet Material**

47 Nominal cabinet dimensions for Transformer 3.1 to 12.5 KVA shall be 20" (D) x 40"
48 (H) x 24" (W).
49

50 8-20.2(1).GR8

51 **Equipment List And Drawings**
52

1 8-20.2(1).INST1.GR8
2 Section 8-20.2(1) is supplemented with the following:
3
4 8-20.2(1).OPT1.ITS.DT1
5 **(NWR ITS September 26, 2005)**
6 **Approval of Material**
7 When submitting material lists for approval, the Contractor shall identify all
8 revisions or changes to manufacturer names, component names, and model
9 numbers listed in these Special Provisions. The Contractor shall also include a
10 brief justification for the revision or change.
11
12 8-20.3.GR8
13 **Construction Requirements**
14
15 8-20.3.INST1.ITS.DT1
16 Section 8-20.3 is supplemented with the following:
17
18 8-20.3.OPT1.ITS.docx
19 **(*****)**
20 **Cabinet Labeling**
21 The Contractor shall mark each ITS device cabinet and transformer cabinet by affixing
22 vinyl lettering which matches the alphanumeric device number as shown in the Plans to
23 the outside of the cabinet. The vinyl letters shall be black on unpainted cabinets and
24 white on painted cabinets. The lettering shall be 4-inch C. The lettering shall be
25 centered horizontally and begin at the top of the cabinet. The first line of text shall be the
26 three number designation of the State Route. The following line(s) shall be the seven
27 character designation of the device(s). The lettering shall be on the side of the cabinet
28 most visible from the roadway. The alphabetical portion of the name shall be lowercase.
29 The Contractor shall install an engraved nameplate, identifying the power source for
30 each cabinet. The nameplate shall consist of white letters on a red background and be
31 permanently affixed to the inside of the cabinet door. The nameplate text shall read
32 "Cabinet Power Source" in ½ inch nominal letters followed by the service name or
33 transformer name (e.g. SUA173 or 522xf02303), as appropriate, in 1 inch nominal
34 letters.
35
36 8-20.3.OPT2.ITS.DT1
37 **(NWR ITS September 26, 2005)**
38 **Cable Vault and Pull Box Labeling**
39 All cable vaults and pull boxes used as part of the ITS System shall be labeled in
40 accordance with Section 9-29.2(4).
41
42 8-20.3.OPT3.ITS.docx
43 **(*****)**
44 **Traffic Data Accumulation And Ramp Metering System**
45 **Model 330 & Model 334 Cabinet Testing**
46 Traffic data accumulation equipment shall undergo two separate sets of tests prior
47 to final acceptance. Initially, the Contractor shall deliver the equipment to the
48 WSDOT Signal Shop in Seattle, Washington for testing. These tests shall check
49 the operation of each individual component as well as the component's ability to
50 operate within the overall system.
51

Shop Testing

Shop testing shall consist of two separate stages:

- a. Stage 1: Notification, Delivery and Assembly
- b. Stage 2: Hardware and Systems Tests

Stage 1: Notification, Delivery and Assembly

Notification

The following documents shall be submitted to the Engineer along with a copy to the Northwest Region Signal Shop, not less than 10 working days before any equipment is delivered to the Signal Shop for testing:

- (1) Contractor's representative for tests: name, title, address and telephone number.
- (2) Inventory of items to be delivered including:
 - (a) The quantity of each item to be delivered;
 - (b) The number of maintenance and operations manuals to be delivered,
 - (c) The number of cabinet prints, equipment schematics, equipment manuals, et al., to be delivered;
 - (d) The contract number the equipment is being tested for.
- (3) Certificate confirming that Type 170 Traffic Signal Control Hardware Specification FHWA IP-78-16, as currently amended, has been met. The certificate shall indicate type and modes of equipment tested, date and place of test, and name of party responsible for conducting the test. The certificate shall include the serial number of the controller.
- (4) Scheduled delivery date of equipment to the Shop.

The Shop will not accept equipment for testing without proper notification.

During Stage 1, the Contractor shall request in writing a Stage 2 start date from the Engineer. The Engineer will provide the Contractor with a written notice of the Stage 2 start date. This date represents the date that Contracting Agency personnel will begin testing the controllers and modems.

Delivery

Delivery shall be made to the Region Signal Maintenance Office located at:

3700 9th Ave. S.
Seattle, WA 98134
Attention: Secretary Supervisor
(206) 442-2110

1 Delivery will be accepted only if all required equipment and materials
2 described in the notification are on hand, between the hours of 8:00 a.m. to
3 1:00 p.m. Mondays, Wednesdays, or Fridays.

4
5 The Contractor shall be responsible for unloading all equipment and materials.

6
7 **Assembly**

8 All equipment shall be completely assembled in preparation for Stage 2 testing.

9
10 **Stage 2: Hardware and Systems Test**

11 The Contracting Agency will limit the Stage 2 testing to 25 calendar days for two
12 controller and cabinet assemblies with 2 additional calendar days for each
13 additional controller and cabinet.

14
15 The tests will verify whether or not the equipment supplied meets Type 170
16 environmental and operating standards and provides the functions and operations
17 required in this contract.

18
19 Only two failures in each controller and cabinet assembly will be allowed. A third
20 failure will result in rejection of the assembly.

21
22 A malfunctioning load switch and/or detection amplifier will not be considered a
23 failure. However, the Contractor shall provide replacement units.

24
25 The Contractor will be notified of all rejections. The Contractor shall remove all
26 equipment that is rejected from the Shop within seven calendar days following
27 receipt of the rejection notice. If not removed accordingly, the Shop will forward the
28 equipment to the Contractor, freight collect.

29
30 Stage 2 testing may extend beyond the allowed test period if:

- 31
32 1. A controller and cabinet assembly fails within the last 7 calendar days of
33 Stage 2; or
34
35 2. A controller and cabinet assembly that replaces a rejected assembly is
36 submitted for testing.

37
38 In order to pass the Stage 2 test, the controller and cabinet assembly must have no
39 failures during the last seven calendar days of the test period.

40
41 The Shop will release no equipment unless all documents are current and correct.
42 Should any document require revising or updating, the Contractor shall provide two
43 copies of that document with the changes marked in red. These documents
44 include, but are not limited, to the following:

- 45
46 1. One reproducible mylar wiring diagram of each cabinet supplied.
47
48 2. Two blue-tone wiring diagrams of each cabinet supplied.
49
50 3. Wiring diagrams for all auxiliary equipment furnished. One set per
51 cabinet.
52

4. Type 170E controller operations and maintenance manuals. One set per cabinet. The Contractor shall provide two extra sets over and above the total number required for all cabinets.
5. Auxiliary equipment operations and maintenance manuals. One set per cabinet.

All equipment except accepted controllers and modems shall be removed from the Shop within seven working days following notice of final approval and acceptance. If not removed accordingly, the shop will forward the equipment to the Contractor freight collect. Accepted controllers and modems shall remain in the shop until requested by the Contractor for the turn-on test.

Communication Device Testing

All communication devices (modems, terminal servers, etc.) will be tested using a Contracting Agency-owned communications data analyzer. The communication devices will be tested over a 24-hour period. Each device is passed if the data analyzer detects no errors over a 24-hour period. Any device failing the test will be rejected. The rejected device shall be replaced at no added cost to the Contracting Agency.

Controller Testing

Controller testing will be primarily communications oriented. However, a hardware failure shall cause the controller being tested to fail the test. Each controller will be tested for communications compatibility with the central computer over a 24-hour test period. The test will be considered successful if communications with the central computer are maintained over the test period.

Communication Failure

Failure to properly communicate with the central computer on each transmission during the 24-hour period shall cause the unit to fail the test. The Contractor shall diagnose the problem and document the solution upon notice of a failure.

Hardware-Oriented Problems

If the problem is hardware-oriented, the Contractor shall remove the failed unit from the TMC for repair or replacement. The repaired or replaced unit and its cabinet shall be delivered to the Shop for complete testing before re-testing at TMC.

Software-Oriented Problems

If the problem is software-oriented, the Contractor shall promptly notify TSMC personnel of the problem. The Contractor shall demonstrate that it is a software problem and not a hardware incompatibility in the controller, to both the Freeway Systems Engineer's and the Engineer's satisfaction.

Work Delays

The Contractor will not be granted an extension of time for delays caused by rejected equipment.

Turn-On Test

Immediately following the field installation of the traffic data station controllers, the Contractor shall demonstrate that all functions of the controllers and cabinets operate as specified, specifically:

1. The ability of the cabinet to interface properly with field wiring and equipment. This shall include communicating with the central computer over the communication lines, and detecting vehicle presence and absence over all induction loops. The Contractor shall correct any interfacing problems resulting from this installation.
2. The ability of the controller to gather, store, and transmit field data to the central computer, including status of field equipment, as specified.
3. The ability of the controller to receive and process commands from the central computer.

The turn-on tests shall be conducted only during the time period between 9:00 a.m. and 2:30 p.m. The Contractor shall notify the Engineer 10 days in advance of the demonstration and perform the demonstration in the presence of the Engineer. TSMC personnel will be on-site to help in transmitting commands from the central computer to the controller(s) at the Contractor's request.

8-20.3.OPT5.ITS.DT1

Closed Circuit Television System

8-20.3.OPT5(A).ITS.DT1

(NWR ITS October 4, 2004)

CCTV Test

The Contractor shall test the CCTV system using a Contractor-supplied NTSC-compatible video monitor and a Contractor-supplied camera control device. The control device may be an IBM-compatible laptop computer with a suitable EIA-422 converter running Vendor-supplied software. The control device and monitor shall remain the property of the Contractor. All test cables and connections shall be the responsibility of the Contractor.

During each testing phase, the Contractor shall repair, replace, or reconfigure each CCTV camera installation as necessary, at no additional cost to the Contracting Agency.

Bench CCTV Test

The Contractor shall perform a bench test on each camera, pan-and-tilt unit, and camera controller prior to installation. The bench test shall be performed at a location proposed by the Contractor and approved by the Engineer. The bench test shall consist of the following:

1. Display camera video on Contractor-provided monitor.
2. Program I.D. generator.
3. Pan and tilt camera.
4. Zoom and focus camera in both fast and slow modes.
5. Turn camera off and on.

6. Change iris between auto and manual.

Local CCTV Test

At each camera control cabinet the Contractor shall connect the video monitor to the coaxial video cable and connect the camera control device to the camera control cable. The Contractor shall demonstrate to the Engineer the following features of the camera installation:

1. Display camera video on the Contractor-provided monitor.
2. Program the I.D. generator to display the State Route on line 1 and the CCTV camera number on line 2.
3. Pan and tilt the camera.
4. Zoom and focus the camera in both fast and slow modes.
5. Turn the camera off and on.
6. Change the iris to auto and manual.

8-20.3.OPT5(B).ITS.DT1

(NWR ITS October 21, 2003)

HUB CCTV Test

At each hub the Contractor shall connect the camera control device to the EIA-232/422 converter. The video monitor shall be connected to the BNC port of the camera video receiver for the camera being tested. In the presence of the Engineer, the Contractor shall demonstrate all of the features listed in the Local CCTV Test section.

8-20.3.OPT5(C).ITS.DT1

(NWR ITS February 11, 2002)

TMC CCTV Test

At the *** \$1\$\$ *** Traffic Management Center, the Contractor shall witness the TMC CCTV Testing as performed by the Contracting Agency. The Contracting Agency will attempt to perform all of the Local CCTV Test features through an existing TMS control console at the TMC.

8-20.3.OPT8.ITS.DT1

Variable Message Sign (VMS)

8-20.3.OPT8(A).ITS.DT1

(NWR ITS February 3, 2003)

Order of Work

The installation of the sign support structure, sign power service, communications to the WSDOT central computer, delivery from manufacturer, installation, and testing shall be shown in the Contractor's CPM schedule. The contractor shall install the VMS within 14 calendar days of delivery from the manufacturer. Within 24 hours of its installation, power shall be supplied to the VMS and its environmental controls fully operational. Also, the Contractor shall have the VMS fully operational and ready to begin testing procedures within 14 calendar days of VMS installation.

System Testing

Testing of the VMS hardware and software furnished and installed for this Contract shall be the responsibility of the Contractor. All variable message signs, VMS control software, VMS control equipment, and cabinets shall be inspected and

1 tested prior to shipment from the factory and after installation in the field. These
2 tests shall demonstrate that each component is fully functional and conforms with
3 these Special Provisions. At a minimum, the tests shall show that all pixels are
4 operational and that the control software provides LED brightness, housing
5 ventilation, message and beacon control. All components that fail a test shall be
6 replaced and re-tested.
7

8 The Contractor shall provide a copy of all Factory Test reports to the Engineer at
9 the time of shipment. The Contractor shall provide the Engineer with a copy of the
10 Field Test reports for each VMS, once the VMS equipment is found to be fully
11 functional. The test reports required by this specification shall include:
12

- 13 1. a list of all equipment used to perform the tests
- 14 2. a record of each test step, who performed the tests, who witnessed the
15 tests, and the test results
- 16 3. a record of test failures, corrective action taken, and results of the retest
17

18 The Engineer reserves the right to perform any independent inspections or tests,
19 which are deemed necessary to ensure that the VMS equipment and software
20 complies with the requirements of the Special Provisions.
21

22 **NTCIP Testing**

23 VMS sign controllers will be tested by the Department using the NTCIP Exerciser
24 in place of the Central Computer. The NTCIP test will use the circuit created to
25 connect the sign controller to the central computer, the modem furnished for this
26 Contract, and the Department's copy of the Exerciser. The Exerciser shall prove
27 that VMS sign controller fully complies with the NTCIP requirements of this Special
28 Provision. The Engineer shall decide any differences in the interpretation of NTCIP
29 Standards. The Contractor shall be responsible for ensuring that the VMS
30 equipment fully complies with NTCIP standards specified herein. The Contractor
31 shall allow 14 days for NTCIP testing. The System Acceptance Test will begin upon
32 completion of the NTCIP test.
33

34 **Acceptance Testing**

35 The VMS sign shall be tested in order to check the operation of the sign. A
36 representative from the manufacturer shall be present during testing of the VMS. A
37 VMS operation manual shall be provided to the Contracting Agency at the time of
38 the test.
39

40 During the 20 day test, the Contractor shall replace all failed sign components.
41

42 The Contractor shall verify remote control of the sign from the Traffic Management
43 Center at Dayton Avenue before scheduling any testing. The Contractor shall
44 demonstrate to the satisfaction of the Engineer that the sign, as a minimum can
45 display diagnostic messages originating from the Dayton Avenue control consoles.
46 Messages shall incorporate the use of the beacons. Testing shall not begin until
47 the sign's basic features have been demonstrated to the satisfaction of the
48 Engineer.
49

50 The test shall be conducted immediately following the complete installation of the
51 new VMS. The Contractor shall demonstrate that all functions of the signs and

1 local controllers are operational. This test shall be conducted in the presence of
2 the Engineer.

3
4 Upon satisfaction of the Engineer that all functions of the system are operational, a
5 20-day test period of continuous operation shall begin. The test period shall be
6 shown in the contractor's CPM schedule. The following shall be observed during
7 the test period:

- 8
9 1. All equipment shall be in working order at the beginning of the test. Any
10 adjustment or replacement of components shall be considered a
11 malfunction and cause for termination of the test period.
- 12
13 2. The system shall operate for 20 consecutive days without malfunction.
- 14
15 3. The VMS shall be communicating with the central computer during the
16 entire 20-day test. Any loss of communication between the VMS and the
17 central computer shall be considered a malfunction.
- 18
19 4. Although it is not necessary for the Contractor to provide personnel to be
20 in attendance during the 20-day testing period, upon being informed of a
21 malfunction, the Contractor shall respond within 48 hours with a
22 representative who is thoroughly familiar with the operation of all parts of
23 the system.
- 24
25 5. Upon detection of a malfunction, the test and test time shall be stopped
26 and the malfunction corrected. Test time will be reset and a new 20-day
27 test period shall begin.

28
29 8-20.3.OPT8(B).ITS.DT1

30 **(NWR ITS February 11, 2002)**

31 **VMS Training**

32 The Contractor shall provide 8 hours of VMS system training for 5 Contracting
33 Agency personnel taught by a manufacturer certified instructor. This shall include
34 classroom instruction at a Contracting Agency facility as well as at the VMS
35 location. Training shall focus on removal and replacement of sign components and
36 manufacturers standard troubleshooting procedures.

37
38 8-20.3.OPT10.ITS.DT1

39 **(NWR ITS April 12, 2004)**

40 **Highway Advisory Radio (HAR) System**

41 **Sign Assembly**

42 Mounting shall be as shown in the Plans.

43
44 **Flashing Beacons**

45 The beacons shall be installed as shown in the detail in the Plans. The flasher
46 units shall be housed within the sign control cabinet.

47
48 **Sign Lighting Luminaire**

49 The luminaires shall be installed as shown in the Plans.

50
51 **Sign Control Cabinet**

52 The control cabinet shall be wired and installed as shown in the Plans.

1
2 **Testing**

3 The Contractor shall demonstrate that upon command from the TSMC the beacons
4 and sign lights can be activated.
5

6 8-20.3.OPT11.ITS.DT1

7 **Communication Conduit System**
8

9 8-20.3.OPT11(A).ITS.DT1

10 **(NWR ITS February 11, 2002)**

11 **Submittals**

12 Within a minimum of 30 calendar days prior to anticipated construction, the
13 Contractor shall provide all documentation pertaining to the materials and method
14 of execution proposed to satisfy the requirements of this section. The Engineer's
15 approval is required prior to the committing of any materials or the commencement
16 of any work.
17

18 The Contractor shall anticipate a minimum of 30 calendar days for approval or
19 disapproval of each submitted item. Actual time for the Engineer's review is
20 dependent upon the completeness and appropriateness of the documentation
21 being submitted. Any deficiencies will require additional time for approval. Any
22 delays caused by such deficiencies will not be considered grounds for extension of
23 project time. The Contractor shall anticipate review intervals to ensure project
24 progress in accordance with Section 1-08.3.
25

26 The Engineer's approval of any submitted documentation shall in no way relieve the
27 Contractor from compliance with the safety and performance requirements as
28 specified herein.
29

30 Submittals required by this item shall include, but not be limited to, the following:

- 31
- 32 1. The manufacturer's specifications for cable vaults and pull boxes.
 - 33
 - 34 2. Detailed shop drawings of pull box and cable vault fabrication.
 - 35
 - 36 3. Manufacturer's specifications for all conduit, fittings and accessories.
 - 37
 - 38 4. Three foot sample of each type (PVC schedule 40 and PVC schedule 80)
 - 39 of conduit with bell ends and one sample of each item listed in the
 - 40 subsection **Accessory Hardware**.
 - 41
 - 42 5. Certificate of compliance with requirements for coefficient of friction and
 - 43 Bellcore GR-356-CORE for innerducts.
44

45 8-20.3.OPT11(B).ITS.DT1

46 **(NWR ITS February 11, 2002)**

47 **Location Wire and Warning Tape**

48 **Warning Tape**

49 Warning tape shall be installed in continuous sections for all underground fiber
50 optic conduit installation where trenching is required. The warning tape shall
51 be installed approximately 6 inches below the surface of pavement or existing

grade. Warning tape shall be installed a minimum of 12 inches into all cable vaults and pull boxes at both ends of the trench.

Location Wire

Wire conductor shall be installed in continuous sections for all underground fiber optic conduit installation where trenching is required. A minimum of 6 feet of location wire shall be extended into each cable vault or pull box. The locate wire shall be attached to the "C" channel or the cover hinge bracket with stainless steel bolts and straps. A 1-foot loop of locate wire shall be provided above the channel as shown in the Plans. Locator wire shall be placed between the conduits in dual conduit installations or on top of conduits for single conduit installations.

8-20.3.OPT13.ITS.DT1

Communication Cables And Interfaces

8-20.3.OPT13(A).ITS.DT1

(NWR ITS February 11, 2002)

Submittals

Within a minimum of 30 calendar days prior to anticipated construction, the Contractor shall provide all documentation pertaining to the materials and method of execution proposed to satisfy the requirements of this section. The Engineer's approval is required prior to the committing of any materials or the commencement of any work.

The Engineer will either approve or disapprove each submitted item within 30 calendar days of submittal subject to the completeness of the Contractor's submittal. Actual elapsed time for the Engineer's review is dependent upon the completeness and appropriateness of the documentation being submitted. Any deficiencies in the Contractor's submittals shall require additional time for approval. Any delays caused by such deficiencies shall not be grounds for extension of project consideration dates. The Contractor shall anticipate review intervals and schedule submittals accordingly to ensure project progress in accordance with Section 1-08.3.

The Engineer's approval of any submitted documentation shall in no way relieve the Contractor from compliance with the safety and performance requirements as specified herein.

Submittals required by this item shall include, but not be limited to, the following:

1. A material staging plan, should the Contractor propose State owned property as a staging area.
2. Manufacturer's complete specifications for all communication system cables and, associated electronics and hardware components.
3. Manufacturer's complete specifications for twisted-pair cable splice enclosures.
4. A detailed fiber optic and twisted-pair cable installation procedure including the following:

- a. Fiber optic cable cutting lengths reflecting the cable order and reel allocations.
- b. Cable pulling plan which shall state the exact operational procedures to be utilized and which identifies the physical locations for equipment placement, proposed equipment setup at each location, pulling tension on all cables for each pull, staffing, and the pulling methodology for each type of cable.
- c. Exact splice points as provided for herein.
- d. Workforce proposed for all equipment, safety, and manual assist operations

5. Factory test data sheets for each reel of cable delivered.

8-20.3.OPT13(B).ITS.DT1

(NWR ITS February 11, 2002)

Cable Installation - General

The Contractor shall determine a suitable cable installation method to ensure that all cable installation requirements shall be met in all conduit sections. All work shall be carried out in accordance and consistent with the highest standards of quality and craftsmanship in the communication industry with regard to the electrical and mechanical integrity of the connections; the finished appearance of the installation; as well as the accuracy and completeness of the documentation.

The Contractor shall make a physical survey of the project site for the purpose of establishing the exact cable routing and cutting lengths prior to the commencement of any fiber optic work or committing any fiber optic materials. Splicing is only allowed for the programmed connection of reels and as shown in the Plans to connect a lateral fiber optic cable to the mainline distribution fiber optic cable. The Contractor shall submit a cable routing plan that shows the locations of all splices. All splice locations other than those shown in the Plans must be approved by the Engineer.

All work areas shall be clean and orderly at the completion of work and at times required by the Engineer during the progress of work.

8-20.3.OPT13(C).ITS.docx

(***)**

Fiber Optic Cable Installation

Fiber optic cables shall be installed in continuous lengths without intermediate splices throughout the project, except at the location(s) specified in the Plans, or as approved in writing by the Engineer.

The Contractor shall comply with the cable manufacturer's specifications and recommended procedures including, but not limited to the following:

1. Installation.
2. Proper attachment to the cable strength elements for pulling during installation.

3. Bi-directional pulling.
4. Cable tensile limitations and the tension monitoring procedure.
5. Cable bending radius limitations.

The Contractor shall protect the loops from tangling or kinking. At no time during the length of the project shall the cable's minimum bending radius specification be violated.

To accommodate long, continuous installation lengths, bi-directional pulling of the fiber optic cable shall be permitted.

In all cable vaults, pull boxes, and at all splice locations cable slack of 50 feet shall be left by the Contractor, unless otherwise specified in the Plans. The 50 feet length of fiber optic cable shall be coiled and secured with tie wraps to racking hardware or as specified in the Plans.

Installation shall involve the placement of fiber optic cables in a specified inner duct as defined in the Plans. The Contractor shall ensure that inner ducts are secured to prevent movement during the cable installation process.

The pulling eye/sheath termination hardware on the fiber optic cables shall not be pulled over any sheave blocks.

When power equipment is used to install fiber optic cabling, the pulling speed shall not exceed 100 feet per minute. The pulling tension limitation for fiber optic cables shall not be exceeded under any circumstances.

Large diameter wheels, pulling sheaves, and cable guides shall be used to maintain the appropriate bending radius. Tension monitoring shall be accomplished using commercial dynamometers or load-cell instruments.

Fiber optic cable lubricant shall be used to reduce pulling tensions for the installation of each fiber optic cable.

Patch Cord Installation

Patch cords placed between pad mounted cabinets shall be protected by 1/2" or 3/8" split yellow loom. The loom shall cover the entire length of the patch cord(s) to within 12 inches of end. The loom shall be installed before the patch cords are pulled into the conduit(s) and be rated for use in electrical installations.

Patch Cords installed within a cabinet shall adhere to the following:

1. Patch cords contained within a patch panel shall not be more than 1 foot longer than required to make the connection.
2. Patch cords between two patch panels shall not be more than 1 foot longer than required to make the connection.
3. Patch cords between a patch panel and a device shall not be more than 2 feet longer than required to make the connection.
4. Patch cords between a patch panel and a device shall be contained inside of 1/2" or 3/8" split yellow loom.
5. Boots shall be glued to the jacket of the patch cord.

1 8-20.3.OPT13(D).ITS.DT1
2 **(NWR ITS October 16, 2006)**
3 **Fiber Optic Cable Splicing**
4 Field splices shall be located as shown in the plans. No additional splices will be
5 allowed without the approval of the Engineer.
6
7 All fusion splicing equipment shall be in good working order, properly calibrated,
8 and meeting all industry standards and safety regulations. Cable preparation,
9 closure installation and splicing shall be accomplished in accordance with accepted
10 and approved industry standards.
11
12 Upon completion of the splicing operation, all waste material shall be deposited in
13 suitable containers for fiber optic disposal, removed from the job site, and disposed
14 of in an environmentally acceptable manner.
15
16 The Contractor shall use the fusion method for fiber optic splicing. Acceptable
17 fusion splicing techniques are:
18
19 Local Injections and Detection
20 Profile Alignment System
21
22 The Contractor shall seal all cables where the cable jacket is removed. The cable
23 shall be sealed per the cable manufacturer's recommendation with an approved
24 blocking material.
25
26 The Contractor shall seal all buffer tubes with an approved blocking material to
27 prevent migration of gel into splice trays.
28
29 All splices shall be contained in splice trays utilizing strain relief, such as heat
30 shrink wraps, as recommended by the splice tray manufacturer.
31
32 8-20.3.OPT13(E).ITS.docx
33 **(*****)**
34 **Fiber Optic Splice Closure**
35 Upon sealing the splice closure, the Contractor shall show that the closure
36 maintains 10 psi of pressure for a 24-hour period.
37
38 8-20.3.OPT13(F).ITS.docx
39 **(*****)**
40 **Fiber Optic Cable Labeling**
41 Permanent cable labels shall be used to identify fiber optic cables at each
42 termination point and in every pull box and cable vault. The cable labels shall
43 consist of a self-laminating plastic black and yellow tag with the words "CAUTION
44 FIBER OPTIC CABLE" and with a space for a custom description of the cable
45 being labeled. The custom portion of the tag shall contain the fiber count, fiber type
46 (SMFO or MMFO), use (mainline, distribution, or other), and cable direction (north,
47 east, south, west).
48
49 Patch panels shall be labeled with 3/8"-1/2" printed laminated labels. The labels
50 shall be located inside the patch panel where they can be read with the door open.
51 The labels shall provide a description of what fibers are spliced to each port in the

1 panel. The description shall include port number, fiber purpose, cable direction and
2 fiber numbers (i.e. "Ports 13-24: Distribution South 1-12").
3

4 8-20.3.OPT13(G).ITS.DT1

5 **(NWR ITS June 7, 2004)**

6 **Twisted-Pair Copper Cable Installation**

7 The Contractor shall install all OSP cables and associated terminal blocks.
8

9 Cables shall be terminated in the communication hubs on a combination
10 connector/protector block, which shall be an AT&T Type 310 bifurcated quick clip
11 terminal block mounted on the wall of the vault. Protection shall be provided for
12 each pair. The surge protector shall be solid state, low voltage (60-90 volts) for
13 non-ringing circuits, 130 volts for ringing circuits and shall have a heat coil for sneak
14 current protection, and gold-plated pins. Protector block ground shall be connected
15 to the ground bus.
16

17 Where cables are terminated at terminal blocks in cabinets, the same pair
18 assignment shall be maintained.
19

20 8-20.3.OPT13(H).ITS.DT1

21 **(NWR ITS February 11, 2002)**

22 **Cable Racking in Pull Boxes and Cable Vaults**

23 The Contractor shall rack the cable in vertical figure eight loops, which shall permit
24 pulling slack from the vaults without introducing twist to the cable.
25

26 Cables shall be secured in racked positions with nylon ties. Identification or
27 warning tags shall be securely attached to the cables in at least two locations in
28 each pull box or cable vault.
29

30 All coiled cable shall be protected to prevent damage to the cable and fibers.
31 Racking shall include securing cables to brackets (racking hardware) that extend
32 from the side walls of the pull box.
33

34 All racking hardware shall be stainless steel.
35

36 8-20.3.OPT13(I).ITS.DT1

37 **(NWR ITS October 16, 2006)**

38 **As-Built Records**

39 The Contractor shall provide the Engineer with a cable route diagram for all
40 installed fiber optic and twisted pair cables. The diagram shall show the actual
41 cable routes and "meter marks" where each cable enters and exits pull boxes,
42 cable vaults, junction boxes, splices and termination points. The Contractor shall
43 record these points during cable installation. The diagram shall also include all ITS
44 device locations as well as the location and quantity of slack cable. The cable
45 route diagram shall be submitted to the Engineer as part of the Fiber Cable Testing
46 documentation.
47

(*****)

Fiber Optic Cable Testing

The installed optical fiber cable shall be tested for compliance with the transmission requirements of this specification, the cable and hardware manufacturer's specifications, and prescribed industry standards and practices.

Prior to commencing acceptance testing, the Contractor shall complete the installation of the fiber optic system. This includes sealing the splice closures, completing the splicing and racking the cables in the pull boxes and cable vaults.

All testing values shall be in metric.

Types of Testing

The two required acceptance tests for optical fiber cable system certification are:

Power Meter testing

Optical Time Domain Reflectometer (OTDR) testing

Power Meter Testing

Power meter testing shall be used to measure the end-to-end attenuation of each new fiber installed between a field device and a communications hub as well as between communications hubs. Power meter testing shall be performed at the 1310 and 1550 nanometer wavelength in both directions.

Prior to commencing testing, the Contractor shall submit the manufacturer and model number of the test equipment along with certification that the power meter has been calibrated within 12 months of the proposed test dates.

The following information shall be documented for each fiber test measurement:

1. Fiber/Strand #
2. Fiber type (Singlemode or Multimode)
3. Cable, tube, and fiber IDs
4. Near end and far end test locations
 - Use device names in Contract plans
5. End-to-end attenuation
 - In each direction and the bidirectional average
6. Length of span being tested
7. Date, time, and operator
8. Wavelength

Optical Time Domain Reflectometer (OTDR) Testing

An optical time domain reflectometer (OTDR) with recording capability shall be utilized to test the end-to-end transmission quality of each optical fiber. Quality tests shall consider attenuation, reflectance, and discontinuities. The OTDR shall be equipped with 1310 nanometer and

1 1550 nanometer light sources for singlemode optical fibers. The OTDR
2 shall be capable of providing electronic and hard copy records of each test
3 measurement.
4

5 The Contractor shall utilize a dead-zone box (a.k.a. launch reel) containing
6 1 km of optical fiber, when performing OTDR tests. The dead-zone box
7 shall be located between the OTDR and the fiber optic connector of each
8 strand tested.
9

10 Each new fiber shall be tested in both directions at the 1310 and 1550
11 nanometer wavelengths. Existing fibers that are spliced to or re-spliced as
12 part of this contract shall also be tested in both directions and at both
13 wavelengths.
14

15 The following information shall be documented for each fiber test
16 measurement:
17

- 18 1. Fiber/Strand #
- 19 2. Fiber type (Singlemode or Multimode)
- 20 3. Cable and fiber IDs
- 21 4. X-Y plot scaled for fiber length
 - 22 • The X-axis (Distance) shall be scaled such that the beginning
 - 23 of the trace starts with the OTDR/dead-zone interface. The
 - 24 end of the trace shall extend no more than 1 km beyond the
 - 25 end of the test span.
 - 26 • The Y-axis (dB) shall be set to maximize the trace. The
 - 27 bottom of the Y scale shall begin above the noise floor and the
 - 28 top of the scale shall be no more than 5 dB higher than the
 - 29 largest event. No events or reflections shall be cut off.
- 30 5. Near end and far end test locations
 - 31 • Use device names in Contract plans
- 32 6. Date, time, and operator
- 33 7. Wavelength
- 34 8. OTDR Settings
 - 35 • Index of Refraction
 - 36 • Averaging time (Minimum of 30 seconds)
 - 37 • Pulse Width (to provide a smooth trace, excluding events)
- 38 9. Table of Events that includes: Event ID, Type, Location, Loss,
39 and Reflection.
 - 40 • Events are defined as:
 - 41 1. Any reflectance event in excess of -60 dB
 - 42 2. Any loss occurrence in excess of 0.05 dB
 - 43 3. Any splice location regardless of loss
 - 44 4. Beginning and end of span
 - 45 • The beginning of the span shall be denoted by the "A-
 - 46 Marker". This marker shall be placed just to the left of
 - 47 the spike of the dead-zone box / fiber interface.
 - 48 • The end of the span shall be denoted by the "B-
 - 49 marker". This marker shall be placed just to the left of
 - 50 the end-of span reflection spike.

Fiber Optic Performance Requirements

1. Splice Loss:
 - Shall not exceed 0.20 dB in one direction
 - Bidirectional Average shall not exceed 0.15 dB
2. Reflectance:
 - Shall not exceed -55 dB

Fiber Cable Testing Documentation

The Contractor shall submit one hard copy and one electronic copy of the fiber test results to the Engineer for approval. Only one OTDR test result shall be on each page. The Contractor shall take corrective actions on portions of the fiber installation determined to be out of compliance with these specifications.

Upon acceptance of the cable installation and test results, the Contractor shall submit three hard copies and three electronic copies of the fiber test results to the Engineer.

Hard copy submittals shall be bound in 3-ring binders. Each 3-ring binder shall have the following information on the front and side:

1. The title "Fiber Optic Test Results"
2. The name of the roadway(s) where fiber was installed
3. Contract name and number
4. Date

The front cover shall also include the following:

1. The size of each cable installed and the beginning and ending mileposts of each cable replaced.
2. The company name address and phone number that did the fiber optic work

Each 3-ring binder shall also include a table of contents and index dividers for each cable segment and each direction tested. The electronic submittals shall be on compact discs and include one licensed copy of the applicable OTDR reader program.

The following information shall be included in each test result submittal:

1. Contract number, contract name, contractor name and address
2. Dates of cable manufacture, installation, and testing
3. Cable specifications
 - Manufacturer data sheet
 - Helix Factor
 - Date of manufacture
4. Fiber (Glass) specifications
 - Manufacturer and Part #
 - Index of Refraction
 - Optical performance (loss/km)
 - Mode Field Diameter
5. As-Built Records (In accordance with the Special Provisions)
6. OTDR test results – No more than one test per page

1 7. Power Meter test results

2
3 Within 30 days of submitting the test results, the Contractor, in the
4 presence of the Engineer, shall re-test a minimum of 5% of the previously
5 tested locations to validate the test results. A 5% sample will be selected
6 randomly from the terminal device locations.
7

8 8-20.3.OPT13(K).ITS.DT1

9 **(NWR ITS September 9, 2002)**

10 **Twisted-Pair (TWP) Copper Cable Testing**

11 The Contractor shall perform a Field Acceptance Test on the installed cable. Each
12 pair shall be tested for frequency attenuation between the communication hub and
13 each ITS device. The State will provide a witness during the tests and the test
14 results shall be documented as prescribed elsewhere in this specification.
15

16 Any pairs showing attenuation greater than 2 dB per mile at 1 kHz shall be cause
17 for rejection of the cable. The Contractor shall replace any cable failing this test at
18 no additional expense to the Contracting Agency. The Contractor shall provide all
19 test equipment necessary to perform the tests.
20

21 All pairs of each underground cable shall be tested for continuity, polarity, shorts,
22 grounds, longitudinal balance, and both resistive and impedance losses consistent
23 with the manufacturer's specifications and standard telecommunication industry
24 requirements
25

26 Each TWP copper cable intended primarily for data communication applications
27 shall be tested end-to-end from the controlled environment vault cable termination
28 point to the interface at the traffic control device. The transmission test procedure
29 shall include the continuity testing of each pair within each TWP cable from the
30 outlet in the termination panel in the vault to the termination outlet at each device
31 location.
32

33 The Contractor shall ensure that all individual wires in all TWP cables have been
34 terminated consistent with the wire insulation color to termination pin requirements
35 set forth in this Special Provision.
36

37 The Contractor shall document the transmission quality test results for 50% of the
38 pairs in each cable of the installed TWP cable and provide documentation for each
39 cable that the cable meets or exceeds the manufacturer's published specifications
40 and otherwise complies with the requirements set forth in this specification for
41 characteristic impedance, longitudinal balance, resistive and impedance losses,
42 and near-end crosstalk.
43

44 The Contractor shall provide the Engineer with the manufacturer and model
45 number of the test equipment and the equipment calibration procedures to be used
46 prior to conducting all tests.
47

48 The Contractor shall test each underground cable end-to-end from the controlled-
49 environment vault-termination block to the terminal block at each cable pedestal or
50 other outside plant terminal equipment. The Contractor shall provide actual test
51 readings for each of the following items to verify the required transmission criteria:
52

1 DC Resistance - The resistance of any conductor in any cable shall not exceed
2 20 ohms per 1000 feet.

3
4 DC Resistance Unbalance - The resistance unbalance between the two
5 conductors of any pair shall not exceed 5%.

6
7 Ambient Noise Measurements - The Contractor shall measure the ambient
8 noise level in dBm0 to determine the level of noise on each cable being tested.
9 The distant end of the pair being tested should be terminated with a 600-ohm
10 resistor. At the near end, an HP-3551 or equivalent transmission measuring
11 set should be configured for conducting a noise reading test. Cable pairs
12 being sampled shall provide an ambient noise figure of 30 Dbm0 (-60 dBm) or
13 better. The Contractor shall record all readings.

14
15 Shield Continuity -Test and measurements shall be made to assure that all
16 underground cable shields are continuous from end-to-end. Each shield shall
17 show a resistance of not more than .75 ohms per 1000 feet.

18
19 Within 30 days of submitting the test results, the Contractor, in the presence of the
20 Engineer, shall re-test a minimum of 5% of the previously tested locations to
21 validate the test results. A 5% sample will be selected randomly from the terminal
22 device locations.

23
24 8-20.3.OPT24.ITS.DT1

25 ***(NWR ITS April 12, 2004)***

26 ***Video, Voice, & Data Distribution And Transmission Systems***

27 The Contractor shall provide and install the following:

28
29 *** \$\$1\$\$ ***

30
31 **Documentation**

32 Documentation for each system element shall consist of the manufacturer's name
33 and model number, serial number when available, materials and operating
34 specifications, wiring schematic and parts list, owners manuals, factory service
35 manuals, and procedures for factory testing and system acceptance testing
36 specified elsewhere herein. The Contractor shall submit three copies of the
37 documentation specified above prior to the installation of the cable or components
38 described in the submittal. In addition, the Contractor shall submit three copies of
39 an overall system wiring schematic and termination chart for the installed TMS
40 elements (operation and maintenance manuals). All documentation for each
41 individual element shall be neatly bound in such a way that the information is
42 secured together and is totally legible without removing the information from the
43 binding. This documentation shall be in addition to any other data, shop drawings,
44 etc. required to be submitted as specified in these Special Provisions.

45
46 8-20.3.OPT25.ITS.DT1

47 ***(NWR ITS February 23, 2009)***

48 ***Communication Hub / Concrete Universal Enclosure (CUE)***

49 The Contractor shall provide shop drawings of the CUE's electrical system,
50 construction, and all component locations and connections. The Contractor shall also
51 provide all cabling for interfacing the CUE alarm contacts with the SONET equipment.
52

1 **Site Preparation**

2 Care shall be exercised in site preparation, in positioning the enclosure on the
3 selected site, and in finish grading to avoid the possibility of a flood condition
4 that would submerge the entranceway. The enclosure shall be placed on a 6-
5 inch sand drainage blanket. The structure excavation Class B, shoring or extra
6 excavation, sand drainage blanket, backfill and compaction shall be in
7 accordance with Section 2-09.

8
9 **Installation**

10 The CUE shall be shipped in one piece to the installation site and installed into
11 the excavation without the need for personnel to be in the excavation.
12 Multiple-piece enclosures requiring assembly will not be accepted.
13 Additionally, the one-piece enclosure shall be structurally and physically
14 suitable for the installation of the system equipment prior to final shipment to
15 the job site.

16
17 A separate, internal ground point shall be provided for the enclosure electrical
18 system and the Contracting Agency's system equipment and shall be labeled
19 as "System Ground." Earth grounding for this point shall be accomplished with
20 two external 5/8-inch by 8-foot copper ground rods and ground wires provided
21 by the enclosure installer.

22
23 **Enclosure Electrical System**

24 The enclosure shall be equipped for 120/240 volt, single-phase, 60 Hz, 100
25 AMP underground utility service from a remote meter pedestal. All conduits
26 shall enter the power transfer switch enclosure via 2.5-inch diameter NPT
27 threaded couplings. A dielectric connection shall be provided at the vault to
28 insure that no grounding is provided by the conduits. The electrical service
29 conductors shall include ground conductor(s).

30
31 The distribution system shall be rated 100 AMP for both Utility and Auxiliary
32 sources. The Utility Service shall connect to a 100 AMP Main Breaker which
33 shall be an integral component of a Power Transfer Switch (PTS). In the
34 NORMAL Position, the Power Transfer Switch (PTS) shall connect the
35 Utility Service through to a 125 AMP Distribution Panel (DP) that contains all
36 Branch Circuit (Breaker) Protection.

37
38 8-20.3(1).GR8

39 **General**

40
41 8-20.3(1).INST1.ITS.DT1

42 Section 8-20.3(1) is supplemented with the following:

43
44 8-20.3(1).OPT1.ITS.DT1

45 **(NWR ITS October 10, 2005)**

46 **Existing System Disruption and Restoration**

47 The Contractor shall use every precaution to ensure that no contract work causes
48 disruptions to the existing systems, except those disruptions that are planned and
49 approved in advance, as defined herein.

50
51 Existing systems include, but are not limited to, the following:
52

- 1 A. All ITS field devices, such as ramp meter, data collection, and CCTV
2 systems, within the project construction limits.
3
4 B. Fiber optic and TWP data and video communication systems on *** \$\$1\$\$
5 ***.
6

7 **Planned Disruptions**

8 Contract work may require disruptions to existing systems, circuits, and
9 equipment. The Contractor shall schedule the work and predetermine the
10 affected system(s), extent, start time, and duration of planned disruptions.
11 Planned disruptions shall be scheduled between the hours of 8 P.M. and 4
12 A.M. If traffic control is required for this work, the Contractor shall also adhere
13 to the allowable closure hours listed in the Special Provisions. Failure of the
14 Contractor to restore disrupted systems and equipment prior to 4 A.M will
15 constitute an unplanned disruption, and the "Restoration Procedure" below will
16 apply.
17

18 **Requirements**

19 Twenty-one calendar days prior to planned disruptions of any existing system,
20 circuit, or equipment, the Contractor shall submit to the Engineer for approval a
21 written Disruption Request. Each Disruption Request shall include the
22 system(s) to be affected, the disruption start date and time, and the estimated
23 duration required. The Contractor shall submit a separate, numbered
24 Disruption Request for each planned disruption. Disruption Request approval
25 or rejection will be returned to the Contractor in writing by the Engineer at least
26 seven calendar days prior to the proposed start of the disruption. The
27 Engineer may reject a requested time or duration and verbally recommend an
28 alternate time or duration agreeable to both the Contractor and the Contracting
29 Agency.
30

31 **Restoration Procedure**

32 Any unplanned disruptions determined by the Engineer to be caused by the
33 actions of the Contractor or the Contractor's representative(s) shall be
34 corrected by the Contractor at no additional cost to the Contracting Agency.
35

36 Upon the occurrence of an unplanned disruption and subsequent notification
37 by the Engineer, the Contractor shall immediately stop all other ITS work in
38 progress, in accordance with Section 1-08.6, and shall expend all efforts to
39 restore the disrupted system(s) or correct the problem causing the disruption.
40 The Contractor will not be granted an extension of time for delays caused by
41 the repair of disrupted systems. Unplanned disruptions shall result in the
42 assessment of liquidated damages in accordance with the subsection
43 **Liquidated Damages** of the Special Provision **PROSECUTION AND**
44 **PROGRESS.**
45

46 8-20.3(1).OPT2.ITS.DT1

47 **(NWR ITS October 4, 2004)**

48 **ITS System Order of Work**

49 The Contractor shall submit for review and approval a proposal for accomplishing
50 the ITS work to the Engineer along with a copy to:
51

52 Freeway Systems Engineer

15700 Dayton Avenue North
P.O. Box 330310 MS-120
Seattle, WA 98133-9710
(206) 440-4462

The proposal shall be approved before any ITS fieldwork begins. The proposal shall include a critical path for ITS construction which shows dates of disconnection, reconnection, and installation of the following ITS components as applicable to this contract:

1. Traffic Data Accumulation And Ramp Metering System
2. Closed Circuit Television System
3. Highway Advisory Radio System
4. Communication Conduit System
5. Communication Cable and Interfaces
6. Variable Message Sign
7. Video, Voice & Data Distribution and Transmission System
8. Environmental Sensor Station
9. Permanent Traffic Recorder Station

The critical path shall also indicate all roadway lane shifts or closures that will be in effect during ITS construction.

8-20.3(1).OPT3.ITS.DT1

(NWR ITS February 23, 2009)

Removal and Delivery of Existing ITS Equipment

Where identified in the Plans, the Contractor shall remove and deliver the existing devices to:

3700 9th Ave. S.
Seattle WA 98134
Attention: Secretary Supervisor
(206) 442-2110
FAX: (206) 442-2147

Five days written advance notice shall be given to both the Engineer and the electrical parts specialist at the address listed above. Delivery shall occur between the hours of 8:00 a.m. and 1:00 p.m. Monday, Wednesday, and Friday. Material will not be accepted without the required advance notice.

Equipment damaged during removal or delivery shall be repaired or replaced to the Engineer's satisfaction at no cost to the Contracting Agency.

8-20.3(5).GR8

Conduit

8-20.3(5).INST1.ESP.DT1

Section 8-20.3(5) is supplemented with the following:

1 8-20.3(5).OPT1.ESP.DT1

2 **(NWR August 10, 2009)**

3 **Conduit Seal, Detectable Tape and Location Wire**

4 Upon installation of wiring, all conduits entering pad mounted cabinets, all conduit
5 entering ITS hubs, and all ITS conduit 2 inches in diameter or larger shall be sealed
6 with an approved mechanical plug at both ends of the conduit run. Installation of
7 mechanical plugs shall conform to the manufacturer's recommendations. Upon
8 installation of wiring at other locations, conduit shall be sealed with duct seal. Upon
9 installation of the pull string, spare conduit shall be plugged.

10
11 A pull string rated for 200 lbs. or greater shall be installed in all spare conduits.

12
13 Detectable underground warning tape shall be placed 12-inches above all innerduct
14 installed in trenches.

15
16 Location 14 AWG stranded orange USE insulated wire shall be placed in
17 conjunction with all innerduct installed in trenches. The location wire shall be
18 placed directly above the conduit containing innerduct in single conduit installations
19 or between the conduits containing innerduct in multiple conduit installations.

20
21 Location wire routed into pull boxes or cable vaults shall be attached to the "C"
22 channel or the cover hinge bracket with stainless steel bolts and straps. A 1-foot
23 loop of locate wire shall be provided above the channel as shown in the Plans.

24
25 8-20.3(5).OPT1.ITS.DT1

26 **(NWR ITS September 26, 2005)**

27 **Cabinet Conduit Sealing**

28 All conduits entering pad mounted cabinets and all conduits entering ITS hubs shall
29 be sealed with an approved mechanical plug at both ends of the conduit run.
30 Conduit duct seal will not be accepted.

31
32 Pad mounted cabinets shall include, but not be limited to, service, signal controller,
33 data station, CCTV, ramp meter, environmental sensor station, gate controller,
34 cable terminal, and transformer cabinets.

35
36 8-20.3(6).GR8

37 ***Junction Boxes, Cable Vaults, and Pull boxes***

38
39 8-20.3(6).INST1.ESP.DT1

40 Section 8-20.3(6) is supplemented with the following:

41
42 8-20.3(6).OPT1.ESP.docx

43 **(*****)**

44 Unless otherwise noted in the Plans or approved by the Engineer, junction boxes,
45 cable vaults and pull boxes shall not be placed within the traveled way or paved
46 shoulders.

47
48 The lid of any cable vault or pull box connected directly to a cabinet foundation
49 shall be at a lower elevation than the cabinet foundation.

50
51 A screened, 2-inch drain pipe shall be provided between all cable vaults or pull
52 boxes and any slope, drainage ditch, swale or pond within 100 feet.

1
2 All junction boxes, cable vaults, and pull boxes placed within the traveled way or
3 paved shoulders shall be heavy-duty.
4

5 Wiring shall not be pulled into any conduit until all associated junction boxes have
6 been adjusted to, or installed in, their final grade and location, unless installation is
7 necessary to maintain system operation. If wire is installed for this reason, sufficient
8 slack shall be left to allow for future adjustment.
9

10 When junction boxes, cable vaults and pull boxes are installed or adjusted prior to
11 construction of finished grade, pre-molded joint filler for expansion joints may be
12 placed around the junction boxes, cable vaults and pull boxes. The joint filler shall
13 be removed prior to adjustment to finished grade.
14

15 Adjustments involving raising or lowering of new or existing junction boxes shall
16 require conduit modification if the resultant clearance between top of conduit and
17 the junction box lid becomes less than six inches or more than ten inches. Wiring
18 shall be replaced if sufficient slack is not maintained.
19

20 The six-inch gravel pad required in Standard Plan J-40.10.01 and J-40.30.00 shall
21 be maintained. When existing junction boxes do not have this gravel pad, it shall be
22 installed as part of the adjustment to finished grade.
23

24 Where conduit and junction boxes are placed in barrier, the prime Contractor shall
25 coordinate the work of the Contractor constructing the barrier and the electrical
26 Contractor so that each junction box placed in the barrier is placed in correct
27 alignment with respect to the barrier, with the face of the box flush. The junction box
28 shall be parallel to the top of the barrier within a 1-degree tolerance. If any point on
29 the face of a junction box placed in barrier is recessed more than 1/8 inch from the
30 surface of the barrier, the Contractor shall install a box extension per the Engineer's
31 approval and grout around the extension or remove and replace the entire section
32 of barrier.
33

34 Heavy-duty Type 4, 5 and 6 junction boxes, cable vaults and pull boxes shall be
35 installed in accordance with the following:
36

- 37 1. Excavation and backfill shall be in accordance with Section 2-09.
38 Excavation for junction boxes, cable vaults and pull boxes shall be
39 sufficient to leave one foot in the clear between their outer surface and the
40 earth bank.
41
- 42 2. Junction boxes, cable vaults and pull boxes shall be installed on a level 6-
43 inch layer of crushed surfacing top course, in accordance with 9-03.9(3),
44 placed on a compacted or undisturbed foundation. The crushed surfacing
45 shall be compacted in accordance with Section 2-09.3(1)E.
46
- 47 3. After installation, the lid/cover shall be kept bolted down during periods
48 when work is not actively in progress at the junction box, cable vault or
49 pull box.
50

- 1 4. Before closing the lid/cover, the lid/cover and the frame/ring shall be
2 thoroughly brushed and cleaned of all debris. There shall be absolutely no
3 visible dirt, sand or other foreign matter between the bearing surfaces.
4
5 5. When the lid/cover is closed for the final time, a liberal coating of anti-
6 seize compound shall be applied to the bolts and nuts and the lid shall be
7 securely tightened.
8
9 6. Hinges on the Type 4, 5 and 6 junction boxes shall be located on the side
10 of the box, which is nearest to adjacent shoulder. Hinges shall allow the lid
11 to open 180 degrees.
12

13 8-20.3(8).GR8

14 ***Wiring***

15
16 8-20.3(8).INST1.ITS.DT1

17 Section 8-20.3(8) is supplemented with the following:
18

19 8-20.3(8).OPT1.ITS.DT1

20 (NWR ITS February 23, 2009)

21 **Traffic Data Accumulation And Ramp Metering System**

22 Existing cabinets with new loops installed shall have all of the existing loop
23 nameplates removed from the display panel. The display panel shall be cleaned of
24 residue and debris. New nameplates shall be installed according to the new loop
25 layout. The new nameplates shall be in accordance with the contract details and
26 specifications.
27

28 8-20.3(9).GR8

29 ***Bonding, Grounding***

30
31 8-20.3(9).INST1.ITS.DT1

32 Section 8-20.3(9) is supplemented with the following:
33

34 8-20.3(9).OPT1.ITS.DT1

35 (NWR ITS February 23, 2009)

36 Where existing ITS conduits are utilized, an equipment-grounding conductor shall
37 be installed except for conduits with innerduct.
38

39 In addition to the conductors called for in the contract, all ITS conduits without
40 innerduct shall be installed with an equipment-grounding conductor and bonding
41 jumpers sized per NEC 250-122 , with the exception that the minimum size shall be
42 8 AWG.
43

44 All new and existing junction boxes, cable vaults and pull boxes that an equipment-
45 grounding conductor is pulled to shall be bonded in accordance with Section 8-
46 20.3(9).
47

48 Location wires shall not be connected to the equipment-grounding system. See
49 "Location Wire and Warning Tape" sections in subsection **Communication**
50 **Conduit System** for attachment of location wires.
51

Supplemental grounding shall be provided at signal standards for ramp meters and steel sign posts for advance warning signs. Foundations for these standards shall be installed with a bare 4 AWG copper wire, which is connected to the reinforcing cage with an approved acorn clamp or exothermic weld and routed to connect to the pole at the grounding lug.

8-20.3(14)C.GR8

Induction Loop Vehicle Detectors

8-20.3(14)C.INST1.ESP.DT1

Section 8-20.3(14)C is supplemented with the following:

8-20.3(14)C.OPT1.ESP.DT1

(NWR August 16, 2010)

Round Loops

Round loops shall be constructed in accordance with the following requirements:

1. Loop conductor and lead in cable shall conform to these Special Provisions.
2. Round sawcuts shall be six feet in diameter and shall be constructed using equipment designed for cutting round loops. The equipment shall use a concave, diamond-segmented blade. The sawcuts shall be normal to the pavement surface and shall be a minimum of 0.25 inches wide. The sawcut depth shall be a minimum of 2 5/8 inches and a maximum of three inches measured at any point along the perimeter, except on bridge decks. Other methods of constructing the round sawcut, such as anchoring a router or flat blade saw, will not be allowed.
3. The bottom of the sawcut shall be smooth. No edges created by differences in sawcut depths will be allowed.
4. All sawcut corners shall be rounded to a minimum 1.5 inch radius.
5. All sawcuts shall be cleaned with a 1000 psi high pressure washer as certified by the manufacturer's label on the machine or as measured by an in line pressure gauge. Wash water and slurry shall be vacuumed out and the sawcut shall be blown dry with compressed air. Disposal of the wash water and slurry shall comply with the requirements of Section 1-07.5(3) and the Special Provision **LEGAL RELATIONS AND RESPONSIBILITIES TO THE PUBLIC**.
6. Loops shall be installed after paving the final lift of roadway surfacing material.
7. The conductor shall be installed one turn on top of the previous turn. All turns shall be installed in a clockwise direction. The conductors shall be secured to prevent floating with 2-inch lengths of high temperature foam backer rod sized for a snug fit. The backer rod shall

be spaced at 2-foot intervals around the perimeter of the sawcut and at corners.

8. Installation of the sealant shall completely encapsulate the loop conductors. A minimum of one inch of sealant shall be provided between the top of the conductors and the top of the sawcut. The top of the sealant shall be flush to 1/8 inch below the top of the sawcut.

9. Use of kerosene solvent is prohibited.

8-20.3(14)C.OPT3.ITS.DT1

(NWR ITS February 23, 2009)

Traffic Data Accumulation And Ramp Metering System

ITS Traffic Data and Speed Induction Loop Detectors - Spacing

Traffic data and speed loops shall be installed 17 feet (± 1 inch) apart, measured from leading edge to leading edge in each lane, as detailed in the ITS plans. Loop spacing not meeting this requirement shall be reinstalled, by the Contractor, in accordance with these provisions at no additional charge to the Contracting Agency.

With the approval of the Engineer, the loop lead in junction box and the entire loop array (set) may be shifted up to 100 ft maximum, where the plan loop locations call for the loops to be installed in existing pavement with joints or severe cracking. If required, additional conduit and junction boxes necessary for loop shifting shall be addressed in accordance with Section 1-04.4.

8-20.3(14)C.OPT3.ESP.DT1

(NWR October 5, 2009)

Existing Traffic Loops

The Contractor shall notify the Area Traffic Engineer through the Engineer a minimum of five working days in advance of pavement removal or grinding in areas with existing loops.

If the Engineer suspects that damage to any loop, not identified in the Plans as being replaced, may have resulted from Contractor's operations or is not operating adequately, the Engineer may order the Contractor to perform the field tests specified in Section 8 20.3(14)D. The test results shall be recorded and submitted to the Engineer. Loops that fail any of these tests shall be replaced.

Loops that fail the tests, as described above, and are replaced shall be installed in accordance with current WSDOT design standards and Standard Plans, as determined by the Engineer.

If traffic signal loops that fail the tests, as described above, are not replaced and operational within 48 hours, the Contractor shall install and maintain interim video detection until the replacement loops are operational. The type of interim video detection furnished shall be approved by the Engineer prior to installation.

1 8-20.3(14)C.OPT5.ESP.DT1
2 **(NWR February 22, 2005)**
3 **Induction Loop Vehicle Detectors**
4 In Section 8-20.3(14)C, Items 2 and 11 and the last two sentences of Item 4
5 are deleted.
6
7 8-20.3(14)D.GR8
8 **Test for Induction Loops and Lead-in Cable**
9
10 8-20.3(14)D.INST1.ESP.DT1
11 Section 8-20.3(14)D is supplemented with the following:
12
13 8-20.3(14)D.OPT1.ESP.DT1
14 **(NWR October 5, 2009)**
15 **Induction Loop Tests**
16 Test A and Test D are revised as follows:
17
18 Test A – The DC resistance between the 2 lead-in cable wires, including
19 the loop, shall be measured by a volt ohmmeter. The resistance shall not
20 exceed 5-ohms or lower the Q of the circuit below 5 where Q is equal to
21 the “Inductive Impedance @ 50 kHz” divided by “Resistance”.
22
23 Test D - An inductance test shall be made to determine the inductance
24 level of each inductance loop. The Contractor shall record the inductance
25 level of each inductance loop installed on the project and shall furnish the
26 findings to the Engineer. An induction level, as measured from the
27 controller cabinet, below 50-microhenries is considered a failure.
28
29 8-20.2.SA1.ITS.DT1
30 **(NWR October 4, 2004)**
31 **Traffic Data Accumulation And Ramp Metering System**

32 **Permanent Traffic Recorder Station**
33 ***Description***
34 The work shall consist of installing a controller cabinet, induction loop detectors,
35 foundation, Contracting Agency supplied piezometer axle sensors for permanent traffic
36 recorder (PTR) station, and all associated equipment.
37
38 ***Materials***
39 The cabinet shall be as shown in the Plans and as specified in the subsection
40 **Transformers and Cabinets** of this specification.
41
42 Equipment inside the PTR cabinet will be provided and installed by others.
43
44 ***Construction Requirements***
45 The Contractor shall notify the Engineer two weeks prior to beginning work on or near a
46 permanent traffic recorder (PTR) station and installing piezometer axle sensor.
47
48 PTR Contact:
49
50 Travel Data Supervisor
51 OSC Transportation Data Office

1 Telephone: (360) 570-2373
2
3 The Contractor shall cut loops in accordance with ITS special provisions and details.
4
5 The Contractor shall install the piezometer in the final lift of asphalt.
6
7 The Contractor shall provide and install one covered terminal block and terminate the
8 power cable from transformer on this terminal block.
9
10 The Contractor shall coil six feet of each 2C(SH) loop wire in the PTR cabinet for future
11 termination. Each loop wire shall be labeled as shown on the Plans.
12
13 8-20.5.GR8
14 **Payment**
15
16 8-20.5.INST1.GR8
17 Section 8-20.5 is supplemented with the following:
18
19 8-20.5.OPT1.ITS.DT1
20 (NWR ITS October 4, 2004)
21 "Closed Circuit Television System", lump sum.
22 "Communication Conduit System", lump sum.
23 "Communication Cables and Interfaces", lump sum.
24 "Video, Voice & Data Distribution & Transmission System", lump sum.
25 "Highway Advisory Radio System", lump sum.
26 "Variable Message Sign", lump sum.
27 "Environmental Sensor Station", lump sum.
28 "Permanent Traffic Recorder Station", lump sum.
29
30 The lump sum contract price for "Closed Circuit Television System", "Communication
31 Conduit System", "Communication Cables and Interfaces", "Video, Voice & Data
32 Distribution & Transmission System", "Highway Advisory Radio System", "Variable
33 Message Sign", "Environmental Sensor Station", and "Permanent Traffic Recorder
34 Station", shall be full pay for the construction of the complete Intelligent Transportation
35 System, modifying existing systems, or both, as shown in the Plans and herein specified
36 including excavation, backfilling, concrete foundations, conduit, wiring, restoring
37 facilities destroyed or damaged during construction, salvaging existing materials, and
38 for making all required tests. All additional materials and labor, not shown in the Plans or
39 called for herein and which are required to complete the Intelligent Transportation
40 System, shall be included in the lump sum contract price.
41